# CANADA — MANITOBA
## Soil Survey

# Soils of the Flin Flon Area

Report D48

Government of Canada | Gouvernement du Canada | Government of Manitoba | Gouvernement du Manitoba

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SOILS REPORT No. D48 1989

# SOILS OF THE FLIN FLON AREA

by

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CANADA-MANITOBA SOIL SURVEY

AGRICULTURE CANADA

MANITOBA DEPARTMENT OF AGRICULTURE

DEPARTMENT OF SOIL SCIENCE, UNIVERSITY OF MANITOBA

## PREFACE

This soil report including map is one in an on-going series of such soil survey reports covering special interest areas in Manitoba. These reports are in response to a growing awareness by various government agencies that support the Canada-Manitoba Soil Survey, that a knowledge of the development and distribution of the soils of Manitoba is the key to understanding their properties, behaviour and response to management. This awareness requires that soils be described both in terms of their basic properties and the nature of the environmental setting in which they are found. Thus, in the rural communities, development for agriculture, recreation and related uses requires delineation of land of high or low suitability for such uses which in turn depends on an accurate and reliable soil map as a basic reference document.

The projected intensive use of the soils in the area of the Town of Flin Flon has created a need for more up-to-date, more accurate and more detailed soil information. Increased examination of soils in the field, the use of current aerial photography, the use of improved methods of studying soils in the laboratory, and the accumulated knowledge of the properties and uses of soils over the years, have all contributed to the additional information contained in this new series of reports and maps.

During the course of the resurvey, a large volume of site specific data for the soils mapped in the Flin Flon area was generated that, for practical reasons, cannot be included in this report. These data are archived in the Canada Soil Information System (CanSIS) data bank. This computerized system of data management permits automated manipulation and statistical evaluation of large volumes of data for soil characterization and interpretations. These data are available on request. In addition, the Cartographic File of CanSIS provides a capability to produce derived maps of various kinds quickly and inexpensively. The types of derived maps that can be generated from the basic soil map include the sixteen interpretations that are provided in tabular form in this report as well as a number of single feature maps such as drainage, texture of surface deposits, slope, and stoniness. A package of interpretive maps and single feature derivative maps can be made available on request from the Canada-Manitoba Soil Survey, Ellis Building, University of Manitoba, R3T 2N2.

The Canada-Manitoba Soil Survey trusts that this report and accompanying map will be of value to all individuals and agencies involved with the use of land within the map area.

## ACKNOWLEDGEMENTS

This soils study was conducted as a joint project of the Canada Department of Agriculture, Manitoba Department of Agriculture and the Soil Science Department of the University of Manitoba.

The soils were mapped by: R.G. Eilers and B.E. Halstead.

The field assistants were: T. Thorleifson and D. Swidinsky.

Laboratory analyses were provided by R. Mirza, K.C. Yeung and J. Madden under the direction of P. Haluschak.

Cartographic Services:

Mapping bases provided by the Land Resource Research Centre, Ottawa.

Map compilation and digitization in preparation for publication and addition to the CanSIS Cartographic File were provided by J. Griffith, R. DePape, and M. Brown.

Manuscript review and soil correlation were provided by R.E. Smith.

Final typing of report manuscript provided by Barbara Stupak.

## SUMMARY

The Flin Flon study area consists mainly of acidic Precambrian bedrock which occupies 42.4% of the project area. Several prominent lakes occupy a further 17.6% of the project area. Miscellaneous land types such as a mine and landfill site account for .7%, and organic soils occupy a further 16.3%. The remainder of the project area consists of calcareous lacustrine clay (13%), moderately to very strongly acidic, coarse textured glacial till (5.7%), and moderately acidic outwash sands and gravels (3%).

The soils best suited for food crop production (gardens and/or special crops) are the well to imperfectly drained clay and silty clay soils. Of the 454 hectares of clay soils, however, most suffer from poor structure (Wabowden soils). Excessive moisture (Roe Lake and Medard soils) and high risk of erosion (Sipiwesk soils) are other limitations to use for gardening purposes.

The presence of bedrock outcrops or at shallow depths below ground level as well as the occurrence of deep organic soils are major factors affecting engineering activities such as housing construction and road building. Recreation activities such as hiking, camping, and playgrounds are also adversely affected by these soil conditions.

## HOW TO USE THIS SOIL REPORT

This soils report contains considerable information about the soils, their origin and formation, their classification and their potential for various uses such as dryland agriculture, irrigation, engineering and recreation. The report is divided into four parts: Part I provides a general description of the area; Part 2 describes the methodology used in the study; Part 3 discusses the development, scientific classification and morphological characteristics of the soils in the study area, and Part 4 provides an interpretation of soil properties and associated landscape features as they affect soil capability or suitability for various uses.

The soil map of the study area is compiled on an air photo base which is included in a pocket of the report folder. The map shows the distribution of soil types and associated landscape features that are significant for potential use as field management units. It provides a linkage from landscapes within the study area to the information contained in the report.

To assist the user in retrieving soil information quickly, the following steps are suggested:

If project consists of many individual maps, proceed with STEP 1; if only single map in pocket, proceed with STEP 2 to 6.

STEP 1 Consult the index to map sheets <u>if</u> the report contains many maps. Locate the areas of interest and note the map-sheet number(s) which identify the township and range on each map.

STEP 2 Consult the soil map in pocket of report folder. Locate the area(s) of interest on the map and identify the pertinent map unit symbols. Arabic numerals placed as superscripts following map symbols indicate the approximate proportion of each soil type within the map unit.

STEP 3 Consult the extended legend accompanying the soil map for an alphabetical listing of soil symbols giving the soil name, classification, drainage and related information concerning landforms, nature and depth of materials, and dominant vegetation.

STEP 4 For interpretive information about the soils, consult the appropriate Table in Part 4. Criteria utilized as guidelines in making these interpretations are provided in the Appendix.

STEP 5 Further information concerning the morphological properties and extent of the soils is presented in Part 3 where the soils are described alphabetically according to soil name.

NOTE: Additional site-specific information not contained in this report is available on request from the Canada-Manitoba Soil Survey, 362 Ellis Building, University of Manitoba, Winnipeg R3T 2N2.

SUMMARY OF SOIL SURVEY COVERAGE FOR MANITOBA
JANUARY, 1989

| Map Project Designation | Name (Soil Report No.) | Report[1] Status | Area in Hectares | Map Unit[2] Description | Survey[3] Intensity Level | Map Scale | Map[4] Base | Land Evaluation[5] & Interpretations |
|---|---|---|---|---|---|---|---|---|
| Detailed Studies and Surveys | | | | | | | | |
| D1 | Pasquia (No. 11) | Pub. 1960 | 57 200 | a,b,d | 3 | 1:63,360 | Color | A |
| D2 | Glenlea Research Station | Int. 1963 | 541 | a,b | 1 | 1:7,920 | Photo | A |
| D3 | Morden Experimental Farm | Int. 1961 | 256 | a,b | 1 | 1:12,000 | Photo | A |
| D4 | Onanole | Pub. 1968 | 768 | a,b | 1 | 1:7,920 | Photo | U |
| D5 | York Factory Area | Int. 1969 | 768 | a | 3 | 1:63,360 | B&W | |
| D6 | McCreary Tile Drain Project | Int. 1971 | 64 | a,b | 1 | 1:5,000 | B&W | A |
| D7 | Brandon Experimental Farm | Int. 1985 | 768 | a,b | 1 | 1:7,920 | Photo | A |
| D8 | Portage Potato Farm | Int. 1972 | 480 | a,b | 1 | 1:4,800 | Photo | A |
| D9 | Portage la Prairie (No. 17) | Pub. 1972 | 113 200 | a,b,c | 2 | 1:20,000 | Photo | A,I,E,U,R |
| D10 | Morden-Winkler (No. 18) | Pub. 1973 | 71 424 | a,b,c | 2 | 1:20,000 | Photo | A,I,E,U,R |
| D11 | Deep Lake | Int. 1975 | 1 400 | a,b | 1 | 1:6,000 | B&W | R |
| D12 | Thompson Environmental Study | Int. 1976 | 32 | a,b | 1 | 1:1,000 | B&W | |
| D13 | Organic Soil Study of Alexander L.G.D. | Int. 1975 | 29 456 | a,b | 3 | 1:63,360 | B&W | A |
| D14 | Winnipeg Region | Pub. 1975 | 306 000 | a,b,c | 2 | 1:20,000 | Photo | A,E,U,R |
| D15 | Brandon Region | Pub. 1976 | 73 250 | a,b,c | 2 | 1:20,000 | Photo | A,E,U,R |
| D16 | Boissevain-Melita (No. 20) | Pub. 1978 | 262 912 | a,b,c | 2 | 1:20,000 | Photo | A,I,E,U,R |
| D17 | Roseau River | Pub. 1977 | 45 200 | a,b | 3 | 1:20,000 | B&W | A |
| D18 | Orr Lake | Int. 1977 | 20 | a,b | 1 | 1:1,000 | B&W | |
| D19 | Pelican-Rock Lake | Pub. 1983 | 14 080 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D20 | West Portage-MacGregor | Pub. 1982 | 124 866 | a,b | 2 | 1:20,000 | Photo | A,I,E,R |
| D21 | Minnewasta | Pub. 1978 | 2 560 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D22 | Killarney | Pub. 1979 | 4 600 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D23 | Matlock-Gimli-Riverton | Pub. 1981 | 18 400 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D24 | Glenboro | Pub. 1979 | 5 960 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D25 | Sandy Lake | Pub. 1980 | 1 720 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D26 | Brokenhead | Pub. 1979 | 10 813 | a,b | 2 | 1:20,000 | Photo | A,E,R,I,U |
| D27 | Rockwood | Pub. 1980 | 12 928 | a,b | 2 | 1:20,000 | Photo | A,E,R,I,U |
| D28 | Oak Lake | Pub. 1979 | 1 293 | a,b | 2 | 1:20,000 | Photo | A,I |
| D29 | Bird River | Pub. 1980 | 2 560 | a,b | 2 | 1:20,000 | Photo | A,E,R |
| D30 | North Shore Lac du Bonnet | Pub. 1980 | 2 400 | a,b | 2 | 1:20,000 | Photo | A,E,R |
| D31 | Grindstone Point | Pub. 1979 | 8 223 | a,b | 2 | 1:20,000 | Photo | A,E,R |

SUMMARY OF SOIL SURVEY COVERAGE FOR MANITOBA (continued)
JANUARY, 1989

| Map Project Designation | Name (Soil Report No.) | Report[1] Status | Area in Hectares | Map Unit[2] Description | Survey[3] Intensity Level | Map Scale | Map[4] Base | Land Evaluation[5] & Interpretations |
|---|---|---|---|---|---|---|---|---|
| D32 | Paint Lake | Int. 1980 | 2 880 | a,b | 2 | 1:10,000 | Photo | A,E,R |
| D33 | Cranberry Portage | Int. 1980 | 80 | a,b | 1 | 1:5,000 | Photo | A,E,R |
| D34 | Dauphin | Pub. 1981 | 8 005 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D35 | South Riding Mtn. | Pre. | 23 488 | a,b | 2 | 1:20,000 | Photo | A,E,R |
| D36 | West Interlake | Pub. 1981 | 10 036 | a,b | 2 | 1:20,000 | Photo | A,E,I,R |
| D37 | Swan R. Townsite | Pub. 1987 | 7 680 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D38 | Hadashville-organic | Pub. 1981 | 6 475 | a,b | 3 | 1:40,000 | Photo | A,E,I,R |
| D40 | Falcon L-Brereton L | Pre. | 39 311 | a,b | 2 | 1:20,000 | Photo | A,E,R |
| D41 | Quesnel Lake-North Shore Winnipeg River | Pre. | 6 009 | a,b | 2 | 1:20,000 | Photo | A,E,R |
| D42 | Duck Mountain | Pub. 1982 | 3 036 | a,b | 2 | 1:20,000 | Photo | A,E,R |
| D43 | Spruce Woods | Pre. | 26 300 | e | 3 | 1:40,000 | Photo | A,E,R |
| D45 | Pine Creek | Pub. 1983 | 1 942 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D46 | Arborg-Riverton | Pub. 1982 | 2 590 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D47 | Roblin | Pub. 1983 | 4 096 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D48 | Flin Flon | Pub. 1988 | 4 600 | a,b | 2 | 1:20,000 | Photo | A,E,R |
| D49 | St. Anne-La Broquerie, Part of L.D.G. Stuartburn | Pub. 1985 | 105 280 | a,b | 3 | 1:50,000 | B&W | A,E,R,I |
| D50 | City of Brandon | Pub. 1984 | 2 980 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D51 | Westbourne | Pub. 1985 | 51,456 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D52 | Notre Dame, Rathwell, Treherne Townsites | Pub. 1984 | 6 144 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D53 | Altona, Emerson, Gretna, Ile des Chenes, Landmark, Letellier, Rosenort, St. Jean Townsites | Pub. 1984 | 14 080 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D54 | Russell, Binscarth-Townsites | Pub. 1984 | 3 791 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D55 | St. Rose Du Lac-Townsite | Pub. 1985 | 1 536 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D56 | Souris, Wawanesa, Virden, Townsites | Pub. 1986 | 6 400 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D57 | Fraserwood, Inwood, Komarno Townsites, Lake Man. Shoreline | Pub. 1987 | 1 856 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D58 | Hallboro, Minnedosa-Townsites | Pub. 1984 | 4 544 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D59 | Beaudry Park | Pub. 1986 | 640 | a,b | 2 | 1:20,000 | Photo | A,E,R |
| D60 | Rural Municipalities of Dufferin, Grey, Roland, Thompson and Stanley | Pub. 1988 | 325 000 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D61 | Meditation Lake | Pre. | 3 072 | a,b | 2 | 1:20,000 | Photo | A,E,R |
| D62 | Wanipigow Lake | Pre. | 8 960 | a,b | 2 | 1:20,000 | Photo | A,E,R |

SUMMARY OF SOIL SURVEY COVERAGE FOR MANITOBA (continued)
JANUARY, 1989

| Map Project Designation | Name (Soil Report No.) | Report[1] Status | Area in Hectares | Map Unit[2] Description | Survey[3] Intensity Level | Map Scale | Map[4] Base | Land Evaluation[5] & Interpretations |
|---|---|---|---|---|---|---|---|---|
| D63 | Shellmouth Resevoir-N | Pub. 1987 | 4 650 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D64 | Assiniboine River | Pub. 1987 | 4 095 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D65 | Villages of Hamiota, Elkhorn, Strathclair, Rapid City, Newdale, Birtle, Shoal Lake | Pre. | 6 204 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D66 | Benito-Durban | Pre. | 18 432 | a,b | 2 | 1:50,000 | Photo | A,E,R,I |
| D67 | St. Eustache, Springstein, Perimeter Strip, Brunkild, La Salle R. | Pre. | 6 200 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D68 | Spruce Point Mine Area | Pub. 1987 | 450 | a,b | 2 | 1:10,000 | Photo | E,R |
| D69 | Snow Lake | Pre. | 2 333 | A,B | 2 | 1:20,000 | Photo | A,E,R,I |
| D70 | Lorne | Pub. 1987 | 93 240 | | 3,2 | 1:50,000 | B&W,Photo | A,E,R,I |
| D71 | Whitemouth Peatland | Pub. 1987 | 10 359 | a,b | 3 | 1:50,000 | Photo | A,E,R,I |
| D72 | Woodlands R.M. | Pre. | 9 728 | a,b | 3 | 1:50,000 | Photo | A,E,R,I |
| D73 | Elk Island-Victoria Beach | Pre. | 2 592 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D74 | S. Norfolk R.M. | Pub. 1988 | 70 912 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D75 | Victoria R.M. | Int. | 67 328 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D76 | Rhineland | Data | 64 512 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D77 | Pembina (con't.) | Data | 27 972 | a,b | 3 | 1:50,000 | B&W | A,E,R,I |
| D78 | Springfield* | Data | 98 270 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D79 | Rockwood R.M.* | Pre. | 116 550 | a,c | 4 | 1:125,000 | B&W | A,E,R,I |
| D80 | N. Norfolk R.M. | Pre. | 110 592 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D81 | Plum Lake | Pre. | 15 500 | a,b | 2 | 1:20,000 | Photo | A,E,R,I |
| D82 | Hanover R.M. | | 7 168 | | 2 | 1:20,000 | | |
| | | | 5 632 | | 3 | 1:50,000 | | |

* Upgrade of Data Base

Reconnaissance Surveys

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| R1 | South Western (No. 3) | Pub. 1940 | 709 600 | d | 3 | 1:125,000 | B&W | A |
| R2 | South Central (No. 4) | Pub. 1943 | 967 600 | d | 3 | 1:125,000 | B&W | A |
| R3 | Winnipeg and Morris (No. 5) | Pub. 1953 | 1 419 200 | d | 3 | 1:125,000 | Color | A |
| R4 | Rossburn and Virden (No. 6) | Pub. 1956 | 1 372 400 | d | 3 | 1:125,000 | Color | A |
| R5 | Carberry (No. 7) | Pub. 1957 | 967 600 | d | 3 | 1:125,000 | Color | A |
| R6 | West-Lake (No. 8) | Pub. 1958 | 592 800 | d | 3 | 1:125,000 | Color | A |
| R7 | Grandview (No. 9) | Pub. 1957 | 689 200 | d | 3 | 1:125,000 | Color | A |
| R8 | Nelson River Basin (No. 10) | Pub. 1973 | 224 000 | b | 3 | 1:100,000 | Color | A |
| R9 | Fisher and Teulon (No. 12) | Pub. 1961 | 949 200 | a,c | 3 | 1:100,000 | Color | A |
| R10 | Swan River (No. 13) | Pub. 1962 | 316 000 | a,c | 3 | 1:125,000 | Color | A |
| R11 | South Eastern (No. 14) | Pub. 1964 | 749 200 | a,c | 3 | 1:125,000 | Color | A,F |
| R12 | Lac du Bonnet (No. 15) | Pub. 1967 | 764 800 | a,c | 3 | 1:125,000 | Color | A,F,R |
| R13 | Grahamdale (No. 16) | Pub. 1971 | 764 800 | a,b | 3 | 1:125,000 | Color | A,F,U,R,E |
| R14 | Red Rose-Washow Bay (No. 19) | Pub. 1975 | 704 400 | a,b | 3 | 1:125,000 | Color | A,F |

SUMMARY OF SOIL SURVEY COVERAGE FOR MANITOBA (continued)
JANUARY, 1989

| Map Project Designation | Name (Soil Report No.) | Report[1] Status | Area in Hectares | Map Unit[2] Description | Survey[3] Intensity Level | Map Scale | Map[4] Base | Land Evaluation[5] & Interpretations |
|---|---|---|---|---|---|---|---|---|
| R15 | Boissevain-Melita (No. 20) | Pub. 1978 | 299 520 | a,b | 2 | 1:40,000 | Photo | A,I,E |
| R16 | Ste. Rose (No. 21) | Pub. 1981 | 676 705 | a,b | 3 | 1:125,000 | Color | A,I,R,E,F |
| R17 | Waterhen (No. 23) | Pub. 1985 | 949 600 | a,b | 4 | 1:125,000 | B&W | A,I,R,E,F |
| R18 | Swan Lake | Data | 599 200 | a,b | 3,4 | 1:125,000 | B&W | A |
| R19 | The Pas (No. 22) | Pub. 1982 | 791 700 | a,b | 4 | 1:125,000 | Color | A,I,E,R,F |
| R20 | Grand Rapids | Pre. | 675 031 | a,b | 4 | 1:125,000 | B&W | A |
| R21 | Cormorant | Int. 1975 | 920 000 | a,b | 4 | 1:125,000 | B&W | A |
| R22 | Wekusko | Pre. | 1 400 000 | a,b | 4 | 1:125,000 | B&W | A |
| R23 | Pointe du Bois | Pre. | 740 000 | a,b | | | | |
| R25 | Red Deer Lake | Pub. 1966 | 34 860 | a,b | 2 | 1:31,680 | Photo | A |
| R26 | Cross Lake and Norway House | Pre. | 615 200 | a,b | 4 | 1:125,000 | B&W | A |
| R28 | Pasquia Lake | Pub. 1984 | 2 330 | a,b | 3 | 1:50,000 | B&W | A,E |
| R29 | Duck Mountain For. Reser. | Data | 363 264 | a,b,c | 4 | 1:125,000 | B&W | A,F,E,R,I |

SUMMARY OF SOIL SURVEY COVERAGE FOR MANITOBA (continued)
JANUARY, 1989

| Map Project Designation | Name (Soil Report No.) | Report[1] Status | Area in Hectares | Map Unit[2] Description | Survey[3] Intensity Level | Map Scale | Map[4] Base | Land Evaluation[5] & Interpretations |
|---|---|---|---|---|---|---|---|---|
| Biophysical and Exploratory Surveys | | | | | | | | |
| B1 | Lake Winnipeg, Churchill & Nelson Rivers | Pub. 1973 | 3 600 000 | e | 4 | 1:250,000<br>1:50,000 | B&W | |
| B2 | Churchill Transportation Corridor | Data 1974 | 179 000 | f | 4 | 1:125,000 | B&W | |
| B3 | 54C Hayes River | Int. 1976 | 1 370 300 | f | 4 | 1:125,000 | B&W | |
| B4 | 54D Kettle Rapids | Int. 1976 | 1 370 300 | f | 4 | 1:125,000 | B&W | |
| B5 | 52M Carrol Lake | Int. 1977 | 634 000 | f | 4 | 1:125,000 | B&W | |
| B5 | 62P Hecla | Int. 1977 | 466 200 | f | 4 | 1:125,000 | B&W | |
| B6 | 53D Deer Lake | Int. 1978 | 629 700 | f | 4 | 1:125,000 | B&W | |
| B6 | 63A Berens River | Int. 1978 | 848 500 | f | 4 | 1:125,000 | B&W | |
| B7 | 53M Knee Lake | Int. 1978 | 1 405 900 | f | 4 | 1:125,000 | B&W | |
| B8 | 53L Oxford House | Int. 1978 | 1 441 100 | f | 4 | 1:125,000 | B&W | |
| B8 | 63H Norway House | Data | 540 800 | f | 4 | 1:125,000 | B&W | |
| B9 | SE 1/4 64A Split Lake | Int. 1979 | 342 400 | f | 4 | 1:125,000 | B&W | |
| B9 | 63P Sipiwesk | Int. 1979 | 1 405 900 | f | 4 | 1:125,000 | B&W | |
| B10 | 53E Island Lake | Pre. | 1 286 900 | f | 4 | 1:125,000 | B&W | |
| B11 | 63H Norway House | Data | | | | 1:125,000 | MSS | |
| E1 | Surface Deposits & Soils of Northern Manitoba | Int. 1963 | | g | 5 | 1:1,267,000 | B&W | |
| E2 | Exploratory Terrain Study of Northern Manitoba and Southern Keewatin, N.W.T. | Int. 1974 | | g | 5 | 1:1,000,000 | B&W | |

1. Report Status
   Pub.-Published Report and Map
   Int.-Interim Report and Map Available
   Pre.-Preliminary Map and Legend Available
   Data-Field Data Available Only

2. Map Unit Descriptions Code
   a-single series and phases
   b-series complexes defined as to proportion
   c-series complexes undefined as to proportion
   d-associations
   e-biophysical units (materials and physiography)
   f-biophysical units (associations & complexes of associations)
   g-regional and local physiographic units

3. Survey Intensity Levels

| Code | Name | Scale | Minimum Size Delineation(ha) | Inspection Density (Approx. range) |
|---|---|---|---|---|
| 1 | Very detailed | >1:12,000 | <1.5 | >1 per 3 ha |
| 2 | Detailed | 1:12,000 to 1:40,000 | 1.5-16 | 1 per 3 to 50 ha |
| 3 | Semi-detailed | 1:40,000 to 1:125,000 | 16 to 256 | 1 per 10 to 1 000 ha |
| 4 | Reconnaissance | 1:125,000 to 1:250,000 | 256 to 625 | 1 per 100 to 110 000 ha |
| 5 | Exploratory | 1:250,000 to 1:1,000,000 | 625 to 110 000 | 1 per 300 to 500 000 ha |

4. Published Map Base Code

Photo-Photomosaic
B&W -Black and white line
Color-Colored line

5. Interpretations Code

A-Agriculture Capability
E-Engineering
F-Forestry
I-Irrigation Suitability
U-Urban Planning and Community Development
R-Recreation

TOTAL HECTARAGE COVERED

| | 1988 | To Date |
|---|---|---|
| Initial Reconnaissance | 12,800 | 19,271,010 |
| Initial Detailed survey | 779 | 18,793 |
| Detailed Resurvey | 97,792 | 3,381,257 |
| iophysical Survey | --- | 12,521,000 |

Published Reports, Maps, Interim Reports, available at a cost of $2.00 per copy (except for D20) from:

Queen's Printer,
Publications Branch,
Manitoba Archives Bldg.,
200 Vaughan St.,
Winnipeg, Manitoba R3C 1T5
Phone:945-3103

Detailed Surveys of Winnipeg Region and Brandon Region available at a cost of $6.00 each from:

Municipal Planning Branch
Manitoba Dept. of Municipal Affairs
1418-405 Broadway Ave.,
Winnipeg, Man., R3C 3L6
Phone: 945-2150

Biophysical Land Classification Maps and Reports available at a cost of $3.50 each from:

Surveys and Mapping Branch
Century Industrial Branch
989 Century Plaza
Winnipeg, Man., R3H OW4
Phone: 945-6666

Preliminary Map and other field data available from:

Canada-Manitoba Soil Survey Office,
Rm. 362 Ellis Bldg., University of Manitoba
Winnipeg, Man., R3T 2N2
Phone: 474-6115 or 474-6118

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## PART 1

## GENERAL DESCRIPTION OF THE STUDY AREA

### 1.1 LOCATION AND EXTENT

This detailed soil study was conducted in the vicinity of the Town of Flin Flon, Manitoba. Flin Flon, which has a population of about 900, is a major mining town located on the Manitoba-Saskatchewan border, approximately 900 kilometers northwest of Winnipeg (Figure 1).

The study area includes approximately 18 sections of land in Townships 66 and 67 of Range 29 west of the Principle Meridian. The major soils of this area were previously mapped at 1:125,000 scale and were described in the interim soil survey report of the Cormorant Lake area (Tarnocai, 1975)[1]. The present detailed resurvey of soils surrounding the town site was carried out at a scale of 1:20,000.

### 1.2 PRESENT LAND USE

The major land uses are urban, industrial, and recreational. There is virtually no agricultural land use activities with the exception of local vegetable and horticultural gardens. Most of the land is non-arable being comprised of exposed granitic rock and shallow to deep wet organic soils. The majority of the non-urban mineral soil areas are not used at present and remain under natural forest.

### 1.3 PHYSIOGRAPHY

The Flin Flon study area is located in the Kazan Uplands portion of the Precambrain Shield[2]. The local physiography is characterized by steep bedrock outcrops inter-mixed with level to moderately sloping shallow to deep mineral and organic deposits. Numerous permanent lakes and wetlands are prominent in the area.

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[1] Tarnocai, C. 1975. Interim Soil Survey Report of the Cormorant Lake Area. Canada Soil Survey, 362 Ellis Bldg., University of Manitoba, Wpg., Man., R3T 2N2.

[2] Canada-Manitoba Soil Survey Unpublished Data.

## 1.4 LANDFORMS

The surface configuration of the bedrock outcrop ranges from hummocky to undulating and ridged. Hummocky areas often contain isolated lows and depressions partially in-filled with shallow morainal deposits underlying deep to shallow organic deposits. The level to gently sloping portions of the study area are characterized by poorly drained organic deposits and well drained lacustrine clay deposits, respectively.

The study area also contains significant numbers of lakes including Cliff Lake, Ross Lake, as well as portions of Lakes Embury, Schist, and Manistikwan.

## 1.5 GEOLOGY

The geology of the Flin Flon area has been previously described by Bailes (1971)[3]. However, because a major portion of the map area consists of exposed bedrock a brief description of the major features is presented here.

The bedrock portion of this study area is composed of volcanic, Gneissic and granitic bedrock. Faults, syclines and anticlines trending in a northwest-southeast direction occur in the central portion of the study area. Most of the faults are parallel to each other and have created numerous elongated water bodies such as Cliff Lake, Channing Lake and Schist Lake. Flin Flon lies in the Greenstone Belt which contains numerous base metals, copper, zinc and gold. Copper and zinc are currently mined by the Hudson Bay Mining and Smelting Co. Ltd. in Flin Flon.

## 1.6 SURFICIAL GEOLOGY

The Flin Flon study area is comprised of 60% non-soil materials which includes water bodies, bedrock, and landfill sites (Figure 2). In the context of this report, surficial geology refers to the materials overlying bedrock. The surficial materials which occupy only 40% (approx. 1800 ha) of the study area, have been derived from glacial ice, glacio-lacustrine, and glacio-fluvial deposition, as well as from more recent accumulations of organic deposits (peat).

The glacial ice deposits consist of very strongly acid, gravelly to sandy loam textured, shallow, discontinuous till overlying bedrock. The till is composed almost entirely of Precambrian materials.

The glacio-fluvial deposits consist of slightly to very strongly acid sands and gravels which occur in localized areas usually adjacent to drainage channels in the central portion of the study area. These deposits, modified by flowing water, are derived from a mixture of Precambrian till and Lake Agassiz deposits.

The lacustrine clay deposits are a legacy of Glacial Lake Agassiz. However, in this area they tend to be somewhat less calcareous than that reported in other regions of the Cormorant area (Tarnocai 1975)[4]. The clay soils in this study are weakly to moderately calcareous and variably

[3] Bailes, A.H. 1971. Preliminary compilation of The Geology of the Snow Lake-Flin Flon-Sherridon Area. Paper #1/71, Manitoba Dept. of Mines and Natural Resources.

[4] Tarnocai, C. 1975. Interim Soil Survey Report of the Cormorant Lake Area, Canada Soil Survey, Winnipeg.

thick over bedrock. Wet clay soils are common in localized depressional areas and adjacent to some of the large lakes. Deep, well drained clay soils occur at higher elevations in the vicinity of larger lakes. The surface of the clay deposits is relatively homogeneous but clay and silt varving is very prominent in the subsoils.

Examples of some of the properties of the mineral soil parent materials in this study area are presented in Table 2.

The organic deposits consist of moderately decomposed organic material derived from forest and fen type vegetation which in most cases is now covered by a thin layer of fibric sphagnum moss. The organic materials vary in thickness from 40 cm to several meters and overlie variable materials ranging from loamy to clayey sediments to bedrock.

## 1.7 RELIEF

The overall relief of the study area varies from less than 300 m.a.s.l. (1,000 ft.) to more than 365 m.a.s.l. (1,200 ft.) (Figure 3). The lowest elevations occur in the central portion of the study area which includes Cliff and Schist Lakes. This area is flanked on both sides by bedrock highs (>335 m.a.s.l.).

Topography is extremely variable ranging from localized areas of level lacustrine and organic deposits to steeply sloping bedrock outcrops. Areas with morainal and fluvial deposits overlying bedrock generally have a more subdued relief. The combination of shallow soils over bedrock and steep slopes are areas of potentially high risk for erosion if surface vegetation cover is disturbed or removed.

## 1.8 SURFACE AND SUBSURFACE HYDROLOGY

Surface and subsurface hydrology are primarily controlled by the characteristics of the bedrock. The direction and rate of surface runoff is determined by slope steepness, aspect and the presence of prominent geologic fault zones. The majority of surface runoff empties into the lakes in the study area or into the shallow peat-filled depressions in the bedrock.

## 1.9 CLIMATE

The climate of the Flin Flon area is characterized by short, cool summers and cold winters, with a mean annual temperature of -0.3 degrees C (Table 3). The coldest month is January (-22.4 degrees C MDT) and the warmest month is July (18.2 degrees C MDT). The mean frost free period is 119 days (Table 4).

The total mean annual precipitation is 473 mm (Table 3). About 51% of the precipitation falls during the period from May to August.

## 1.10 VEGETATION

The Flin Flon study area lies within the Boreal Forest Region delineated by Rowe[5]. Black spruce is very common on poorly drained sites with aspen and balsam poplar occurring on the well to imperfectly drained sites. Jack pine occurs on the well drained, shallow (lithic) morainal deposits overlying Precamb-

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[5] Rowe, J.S. 1972. Forest Regions of Canada. Canadian Forestry Service, Department of the Environment. Publ. No. 1300.

rian rock. Dogwood and alder are also common in the well drained sites. Willows, shrubs and horsetail are common ground cover on the imperfect to poorly drained soils.

Willow, tamarack and dwarfed bog birch occur on the very poorly drained organic soils. Ericaceous shrubs, Labrador tea, sedges, sphagnum and feathermosses are typical of ground cover on the fen peat lands.

## 1.11 SOIL DEVELOPMENT

The soils of the Flin Flon area have developed under a subarctic climate and boreal forest vegetation. The impact of these factors has been modified somewhat by relief, drainage and bedrock. The degree of profile development which has occurred since the retreat of Glacial Lake Agassiz is also a function of the mineralogy and composition of the soil parent material. Therefore, because soil development is a function of these variables the types of soil found in this study area vary considerably.

The four major processes of soil formation involve the leaching, transformation, translocation and accumulation of soluble constituents in the soil parent materials. The result of these processes is a distinctive layering of the soil with depth. When viewed in vertical cross-section, a mature soil is seen to consist of various layers called soil horizons. The main horizons (master horizons) for mineral soils are designated by the letters A, B, and C[6]. The A and B horizons reflect genetic processes and together make up the solum of the soil.

Surface layers or A horizons are subject to the greatest amount of weathering and leaching and/or organic matter accumulation. The B horizons lying immediately below the A horizons contain most of the material leached from the A horizons or have been otherwise altered by soil forming processes. The C horizons represent the relatively less weathered parent material from which the solum has developed.

## 1.12 SOIL CLASSIFICATION

The dominant well drained soils in the study area are classified as Brunisols and Grey Luvisols. The poorly and very poorly drained soils are classified as Gleysols and organic soils.

Brunisolic soils have developed under forest vegetation on glacial till and outwash parent materials derived almost entirely from acidic Precambrian rocks. These Brunisolic soils have a moderately acid solum, a leached mineral- organic surface horizon overlying a weak Bfj, Btj or Bm horizon and are classified as Eluviated Dystric Brunisols.

The Grey Luvisolic soils have also developed under forest conditions but on calcareous lacustrine clay as opposed to acidic parent materials. The leaching of bases from the solum and the translocation of clay into the B horizon are the major soil forming processes in these soils. This results in the formation of light colored, eluviated Ae horizons at the surface overlying a darker colored, fine textured illuvial Bt horizon. The underlying C horizons are typically lighter in color and calcareous. Under virgin conditions an organic surface horizon, L-H is present.

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[6] "The Canadian System of Soil Classification". 1978. Research Branch, Canada Dept. of Agriculture, Ottawa.

Gleysolic soils are poorly drained mineral soils whose profiles reflect the influence of waterlogging for significant periods. These soils are saturated with water and are under reducing conditions due to lack of aeration either continuously or during some period of the year. The effects of these conditions in Gleysolic soils are reflected by the occurrence of gleyed horizons having dull grey to olive greenish or bluish gray colors frequently accompanied by prominent, usually rusty colored mottles, resulting from the localized partial oxidation and reduction of hydrated iron oxides. In their natural state Gleysols develop a variety of surface horizons ranging from thin peaty O horizons to organic-mineral Ah and Ae horizons. They may or may not have B horizons.

In the Flin Flon area, these soils are generally not leached and as a result are classified as peaty Rego Gleysols, meaning these soils have no A or B horizons but do have a thin peaty O horizon. Some Rego Gleysols may contain carbonates to the soil surface.

Organic soils are those that have developed dominantly from organic deposits which by definition contain over 30 percent organic matter and meet minimum specifications of depth and thickness for defined control sections. Organic soils overlying bedrock can, by definition, be as thin as 10 cm. However, when overlying other mineral material, they range in depth from 40 cm to more than 160 cm. They are the soils that in the past have been referred to as muskeg, peat and muck soils of bogs, fens, swamps, marshes and moorlands. Most occur naturally under wet or very poorly drained conditions. Their composition of organic material according to origin such as moss, forest peat, woody peat, fen peat; their degree of decomposition; their depth to and nature of underlying mineral soils are important criteria in classifying organic soils.

The degree of decomposition is identified by the connotative descriptive terms fibric, mesic and humic. The depth to mineral contact is used to differentiate shallow (Terric) organic soils. Moderately decomposed organic soils overlying continuous mineral soil at depths between 40 and 160 cm are classified as Terric Mesisols. Moderately decomposed organic materials greater than 160 cm thick are classified as Typic Mesisols[7]. Organic layers less than 40 cm thick are classified as peaty phases of mineral soils usually in the Gleysolic Order.

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[7] For more details, see "The Canadian System of Soil Classification". 1978. Research Branch, Canada Dept. of Agriculture, Ottawa.

Table 2. Some Properties of Surface Deposits (Soil Parent Materials)*

| | Clay (Lacustrine) | | | | Sandy Loam (Glacial) | | | | Sandy/Clay | | | Sandy (Fluvial) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | WBW | SWK | MRD | $\bar{x}$ | FYK | WVT | WVT | $\bar{x}$ | CLF | CNN | $\bar{x}$ | PCP | PCP | $\bar{x}$ |
| %S | 5 | 7 | 18 | 10 | 76 | 74 | 83 | 78 | 85/11 | 94/2 | 90/6 | 86 | 96 | 92 |
| %Si | 39 | 47 | 33 | 40 | 20 | 18 | 16 | 18 | 8/43 | 5/16 | 6/30 | 7 | 2 | 4 |
| %C | 56 | 46 | 49 | 50 | 4 | 8 | 1 | 4 | 7/46 | 1/82 | 4/64 | 7 | 2 | 4 |
| pH | 6.5 | 7.7 | 6.9 | 7.0 | 4.8 | 4.4 | 4.8 | 4.7 | 7.0/7.5 | 5.8/6.4 | 6.4/6.9 | 6.4 | 4.7 | |
| E.C. | .2 | .6 | .3 | .3 | .2 | .1 | .1 | .1 | .2/.3 | .2/.2 | .2/.2 | .4 | .1 | .2 |
| $CaCO_3$ equiv. | - | 8.2 | - | - | - | - | - | | -/7.4 | - | -/? | - | - | |

* Data for C or C/2C mineral horizons of indicated series

%S = percent sand, %Si = percent silt, %C = percent clay, E.C. = electrical conductivity (dS/m)

$\bar{x}$ = average value

Table 3. Temperature and Precipitation Data Recorded at Flin Flon, Manitoba (Lat. 54° 46'N, Long. 101° 51'W, Elevation 335 m.a.s.l.)*

| Month | Mean Daily Maximum °C | Mean Daily Minimum °C | Mean Monthly °C | Mean Monthly Rainfall mm | Mean Monthly Snowfall mm | Mean Monthly Total mm |
|---|---|---|---|---|---|---|
| January | -18.3 | -26.4 | -22.4 | 0.0 | 20.6 | 20.6 |
| February | -12.0 | -22.2 | -17.1 | 0.0 | 18.4 | 18.4 |
| March | - 4.6 | -16.2 | -10.4 | T | 23.7 | 23.7 |
| April | 6.3 | - 4.8 | 0.7 | 6.8 | 15.6 | 22.4 |
| May | 14.8 | 3.2 | 9.0 | 39.8 | 4.0 | 43.8 |
| June | 20.3 | 9.6 | 15.0 | 64.4 | T | 64.4 |
| July | 23.4 | 13.0 | 18.2 | 76.4 | 0.0 | 76.4 |
| August | 21.6 | 11.3 | 16.5 | 60.3 | 0.0 | 60.3 |
| September | 13.8 | 5.4 | 9.6 | 58.4 | 1.1 | 69.5 |
| October | 6.8 | - 0.2 | 3.3 | 25.5 | 9.2 | 36.7 |
| November | - 4.6 | -11.1 | - 7.9 | 0.7 | 25.4 | 26.1 |
| December | -13.9 | -21.1 | -17.5 | 0.2 | 22.5 | 22.7 |
| Yearly | 4.5 | - 5.0 | - 0.3 | 332.5 | 140.5 | 473.0 |

* Data obtained from Canadian Climate Normals, 1951-1980, Volume 2, Temperature and Volume 3, Precipitation, Atmospheric Environmental Service, Environment Canada, 1982.

Table 4. Degree Days[1] Above and Below 0°C, and Frost-Free Periods[2] Recorded at Flin Flon During the Period 1951-80

| Month | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sept. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Degree Days Above 0°C | 0.1 | 0.1 | 7.1 | 89.0 | 283.4 | 449.4 | 563.7 | 510.7 | 289.8 | 125.4 | 8.9 | 0.0 | 2327.5 |
| Degree Days Below 0°C | 700.4 | 481.3 | 321.9 | 67.1 | 1.9 | 0.0 | 0.0 | 0.0 | 0.9 | 23.1 | 245.1 | 536.7 | 2378.4 |

| Shortest Frost Free Period | Probability of Frost Free Period Equal to or Less than Indicated (Days) Period | | | | | | | Longest Frost Free Period |
|---|---|---|---|---|---|---|---|---|
| | 10% (1 in 10) | 25% (1 in 4) | 33% (1 in 3) | 50% (1 in 2) | 66% (2 in 3) | 75% (3 in 4) | 90% (9 in 10) | |
| 100 | 102 | 110 | 112 | 119 | 126 | 128 | 137 | 153 |

* A degree day is defined as a measure of the departure of temperature for a day from some reference temperature, expressed in °C.

[1] Environment Canada, 1982. Atmospheric Environment Service, Canadian Climatic Normals, Degree Days, 1951-80, Vol. 4.

[2] Vol. 6, Frost.

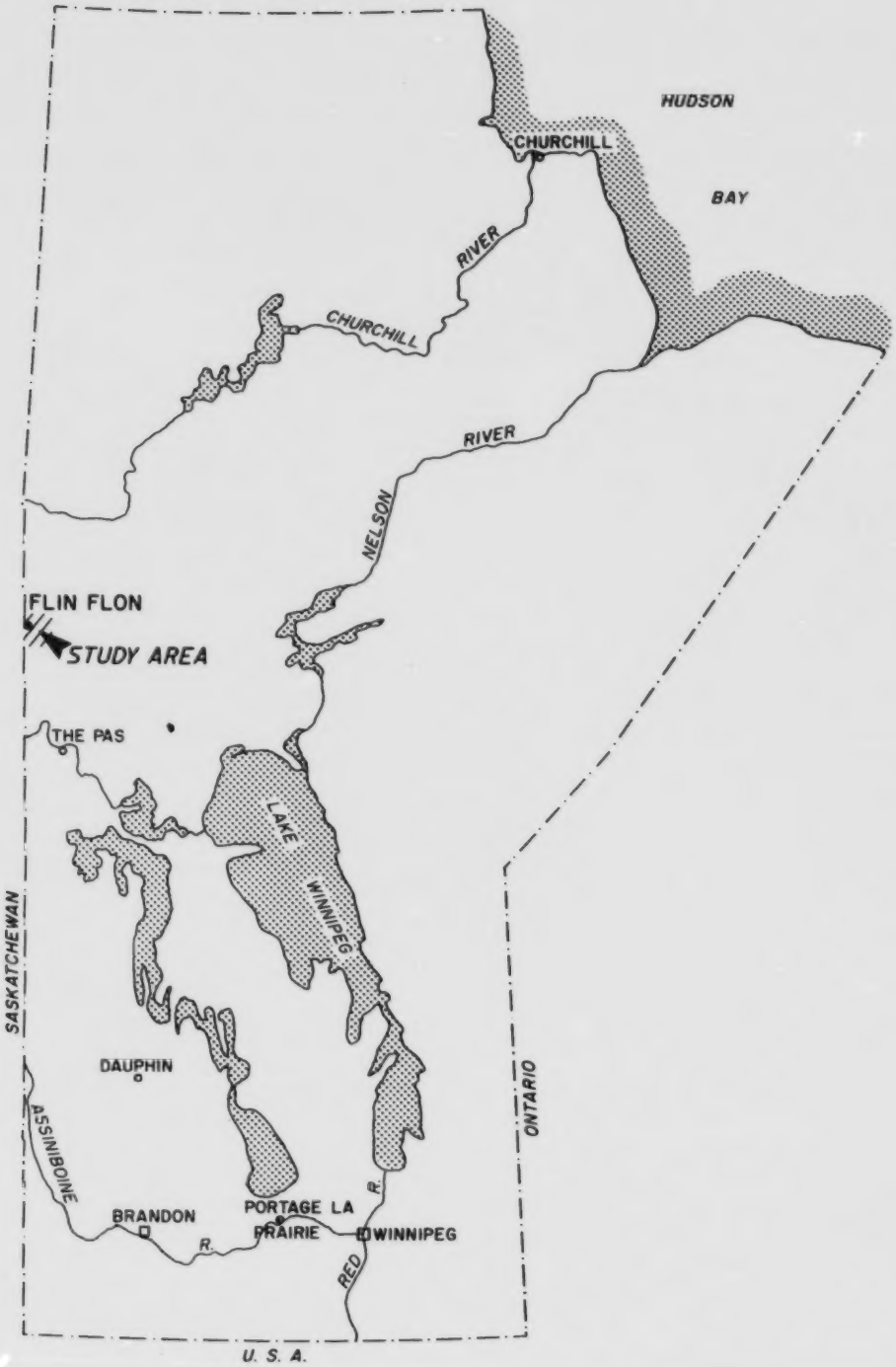


**Figure 1:** Location of Flin Flon Study Area.

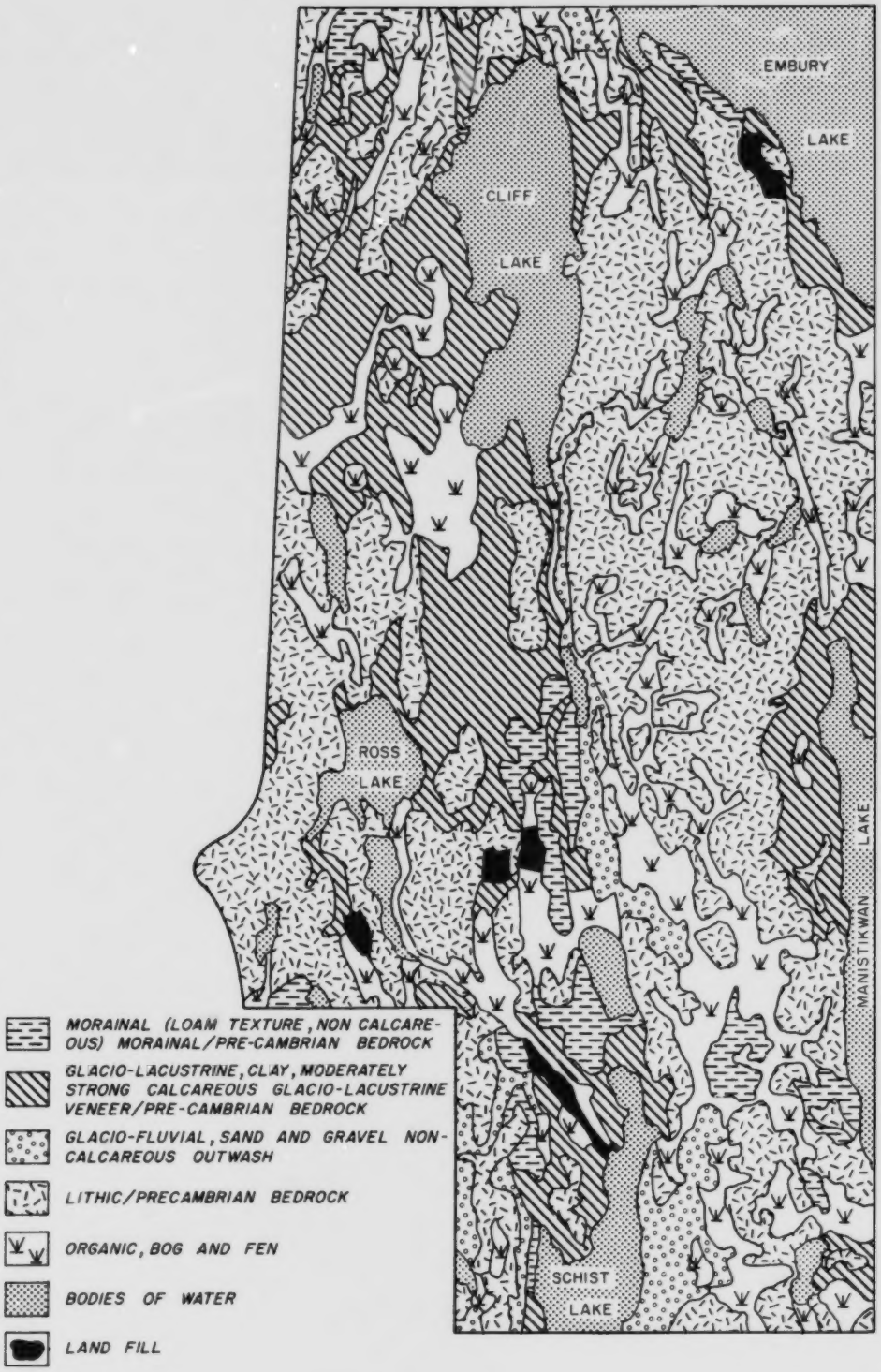


**Figure 2:** Surficial Geology of the Flin Flon Study Area.

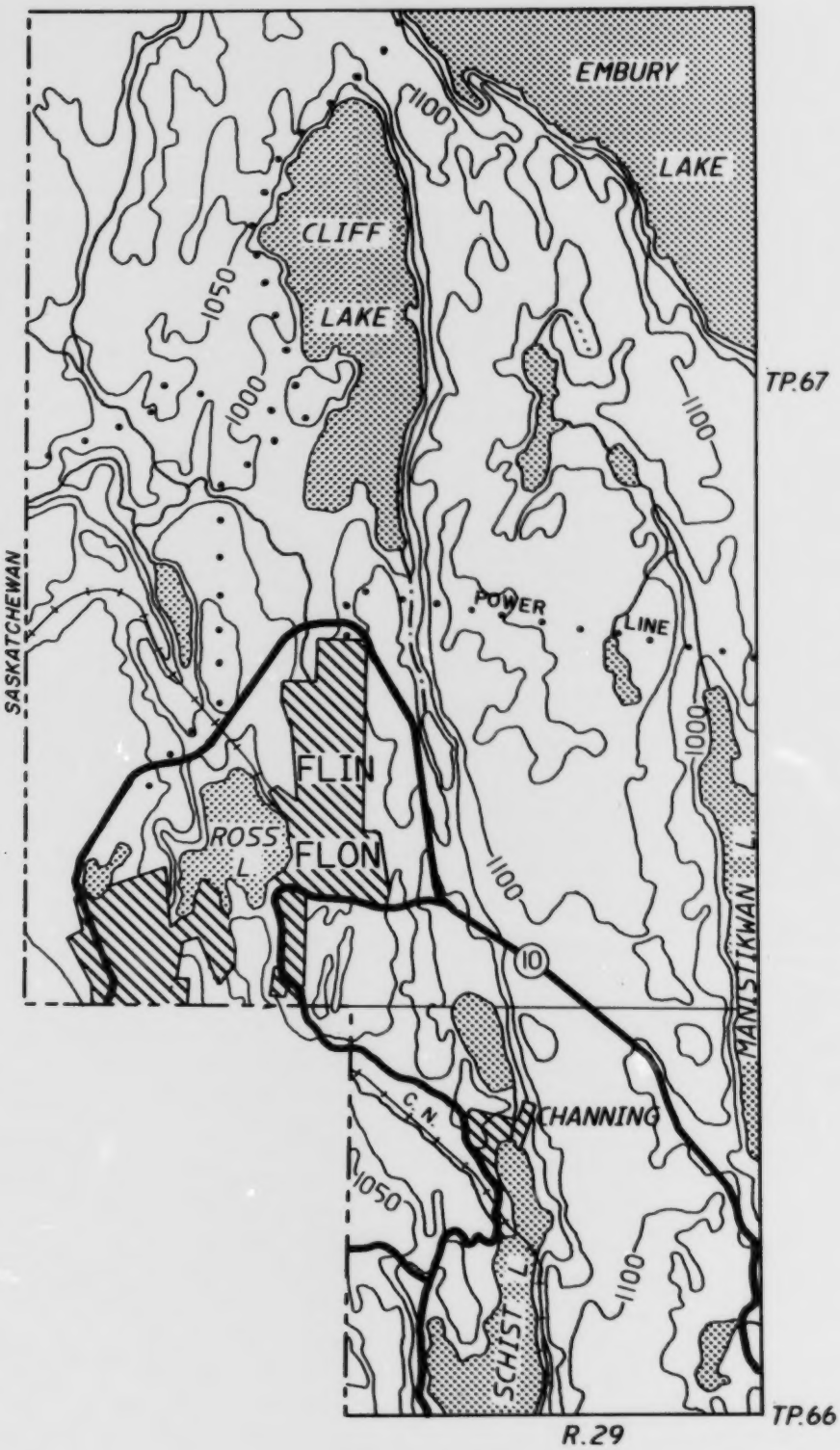


**Figure 3:** Relief of Flin Flon Area.

## PART 2

## METHODS

### 2.1 FIELD INVESTIGATIONS

Field investigations were conducted at regular intervals along available roads and at intervals of about 150-200 m along selected traverses throughout the study area. The soil legend for mapping was adapted from Tarnocai (1975)[8]. Soil profiles were examined to a depth of 1 meter at each site and detailed information was recorded as to landform, drainage, parent material and soil profile characteristics. This data was recorded on daily field forms and later input to the Canada Soil Information System (CanSIS) Data Bank for Manitoba[9]. The use of aerial photointerpretation techniques aided in the initial selection of ground inspection sites and traverses, and was also used to extrapolate soil conditions and boundaries between inspection sites. Detailed soil mapping was conducted at survey intensity level (SIL) 2[10], and the map was published at a scale of 1:20,000. At this scale, the minimum practical size of delineation of significant soil areas is approximately one hectare.

Note: All site specific soils information obtained during the course of this survey project, is available on request from the Canada-Manitoba Soil Survey, Ellis Building, University of Manitoba.

### 2.2 MAP UNITS

There are two kinds of mapping units employed in the resurvey of soils in Manitoba. They are simple mapping units and compound mapping units.

Simple mapping units are usually occupied by one kind of soil series, the properties of which vary within narrow limits. Often as not they contain minor inclusions of related but unlike soil types. The proportion of such unlike soils tends to increase as the intricacy of soil pattern increases or as the intensity of ground truthing decreases. In any event, such mapping units are usually named after the dominant soil series and any available information about the soil series is generally applicable to the entire mapping unit. Predictions concerning soil conditions

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[8] Tarnocai, C. 1975. Interim Soil Survey Report of the Cormorant Lake Area, Canada. Soil Survey, Winnipeg.

[9] Canada Soil Survey Committee. 1978. "Manual for Describing Soils in the Field". Canada Soil Information System (CanSIS), Canada Dept. of Agriculture, Ottawa.

[10] Mapping Systems Working Group (K.W.G. Valentine, Ed.). 1981. "A Soil Mapping System for Canada, Revised". Land Resource Research Inst., Agriculture Canada, Ont.

and behaviour can be done confidently.

Compound mapping units on the other hand, usually contain significant proportions of two or more unlike soil series. These soils are related geographically but can not be mapped or delineated separately because of a combination of such factors as the intricacy of soil pattern, map scale and survey effort. In many compound map units, differences in soil types and other characteristics are strongly contrasting. Dominant, subdominant and minor (if strongly contrasting) soil series are identified and the relative proportion that each occupies within a single map delineation is specified. In compound map units, interpretation or suitability ratings can only be applied to that portion of the mapping unit occupied by each identified soil series. In order to apply interpretations to field conditions, it is essential that users determine where each identified soil series in the mapping unit occurs in the landscape. Information contained in the legend accompanying the soil map and other sections of the report is useful for this purpose.

A second type of compound mapping unit is called a <u>soil complex</u>. This compound mapping unit usually contains two or more related but unlike soil series which occur in unspecified proportions. In most cases, the differences in soil profile and other characteristics are not strongly contrasting. Soil complexes are often employed in the mapping of outwash deposits and organic soil areas. In such areas soil profile variability occurs over such short intervals of distance that the proportions of constituent soil series within each map unit delineation is not possible to determine without excessive ground truth effort. Interpretations applied to such units cannot be employed with the same degree of confidence as in the case of simple or more specifically defined compound mapping units.

Soil series are usually assigned local geographic names and are represented on the soils map by three-letter alphabetical codes. Additional features of the landscape which may affect land use interpretations are expressed as phases. Topographic phases are used to indicate the most significant slope class in each map unit delineation. Slope variations are indicated in the denominator portion of the map symbol. The convention employed to indicate this feature in the map symbol is as follows:

If topographic slope classes are observed to be significant, the map symbol representing the typical soil series is used with the appropriate letter placed below the soil series symbol. The degree or magnitude of variation is designed as follows:

Topographic Slope Classes

| Symbol | Description |
|---|---|
| x - | less than 2 percent slope |
| c - | 2 to 5 percent slope<br>- very gentle slopes |
| d - | 5 to 9 percent slope<br>- gentle slopes |
| e - | 9 to 15 percent slope<br>- moderate slopes |
| f - | 15 to 30 percent slope<br>- strong slopes |
| g - | 30 to 45 percent slope<br>- very strong slopes |

e.g. $\frac{\text{FYK}}{\text{d}}$

Indicates that the delineation on the map consists of Faye Lake soils on gentle 5 to 9 percent slopes.

Delineated areas that are homologous in soil properties and external features are labelled as simple or pure mapping units.

For example, the following map unit delineation coded:

WBW

indicates that the area is composed of soils belonging to the Wabowden Series on level to very gently sloping (less than 2 percent slope) terrain.

Where different soils or external properties occur in intricate patterns or in such small areas that it is not practical to delineate them separately because of map scale, they are combined to form compound map units. The soil series and phases that occur in such units are indicated by their individual symbols and the relative extent of each is indicated by percentile proportions.

Compound symbols are interpreted as follows:

$$\frac{aR^{7} - WBW^{3}}{c}$$

This compound map unit consists of 70 percent Acidic Bedrock with dominantly c topography (2-5 percent slopes), and the remainder of the map unit consists of 30 percent Wabowden series on level to very gentle slopes.

The delineation of map units, whether they consist of single soil series or soil series complexes, is not an exact science. The decision to outline and label any given area is based on interpretation and extrapolation of observed soil and landscape features. These observations are usually the combined result of field investigations and air photo interpretation. The delineation and extension of soil boundary lines serve as guides for separating soil properties and conditions that are significantly different. Soil boundaries, therefore, are not exact lines but rather are approximations of the areas of significant changes in soil condition, soil properties and profile distributions.

## 2.3 SOIL SAMPLING

During the course of field investigations and mapping, numerous soil sites were sampled at selected locations for soil characterization and classification studies. Representative samples were selected from several sites to assess the characteristics and uniformity of the parent materials.

In total, 16 representative soil profiles were sampled in detail for chemical and physical analysis. These sites, representing the major soil parent material groups in the area, were used for site characterization and correlation, and to provide data for the various engineering and recreational interpretations contained in this report.

A detailed description and laboratory analysis for each profile sampled is provided in Appendix D.

## 2.4 MAPPING RELIABILITY

In addition to the detailed sample sites, approximately 250 other soil and site inspections were made during the course of this survey (Figure 4). In terms of the total area of the project (approx. 4,598 ha) this represents a survey intensity level of 18 ha per inspection. However, in terms of real soil inspections, that is if the area of bedrock, water bodies and landfill sites are excluded, 250 inspections gives a survey intensity level of 7 ha per inspection. This intensity of inspection and the striking contrast between soil and non-soil patterns on aerial photos permitted confident delineation of map units at a scale of 1:20,000.

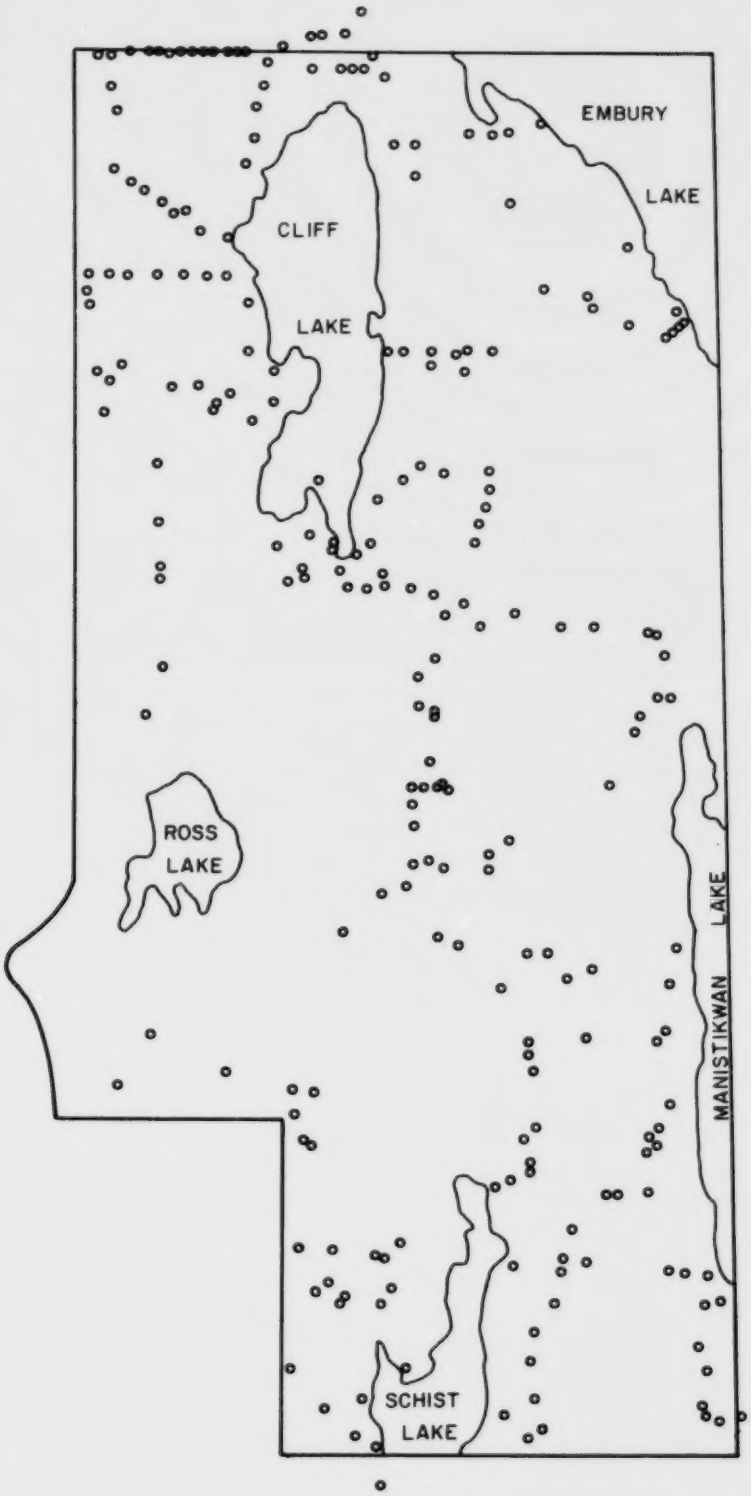



**Figure 4:** Location of Field Inspections and Sample Sites.

## PART 3

## DESCRIPTION OF SOILS

The relationships between surface deposits and associated soils mapped in this study is presented schematically in Figure 5. A descriptive legend of the parent materials and associated soil series along with their estimated extent in the Flin Flon area is presented in Table 5.

A generalized description of each soil series mapped in this study includes: name, extent, genetic profile type, texture, parent material, topography and drainage. The series descriptions are arranged in alphabetical order. More detailed morphological descriptions and physical and chemical characteristics for a number of selected soils are provided in Appendix D. Information on their suitability and management requirements for various uses is presented in the following section of this report.

### 3.1 SOIL SERIES

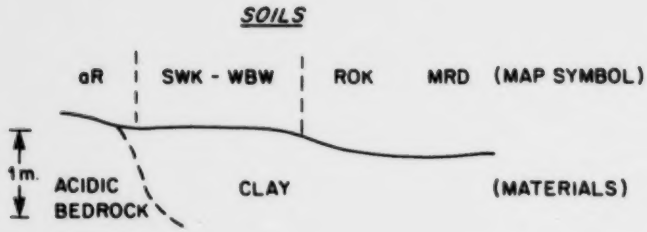
The generalized soil descriptions that follow are based on summaries and averages of soil data systematically documented and recorded during the course of the field survey. Each soil inspection has been recorded on CanSIS Daily Field Forms.

**Acidic Bedrock (aR)**

Acidic Bedrock underlies the entire study area, with outcrops occupying more than 42% of the area. Minor inclusions of mineral and organic soils occur in intimate association with these outcrops. Deeper soils, both mineral and organic (Figure 6a) occur in deeper crevasses and channels in the more hummocky bedrock which provides more protection and suitable local environment for their development. On the level to gently sloping bedrock outcrops there has been less protection and thus a more harsh environment for soils to develop (Figure 6b).

Surface Deposits

Bedrock - Clay Lacustrine
- Depth of clay over rock is variable. Areas with shallow clay (<1 m) were observed but were not extensive enough to map.




Bedrock - Sandy Loam Till
- Thickness of till on rock is variable and discontinuous.

Bedrock - Gravel Outwash
- Thickness of coarse textured deposits over bedrock is variable. Areas mapped as aR - PCP will contain some soils <1 m thick. Sandy deposits on clay occur in some bedrock channels.

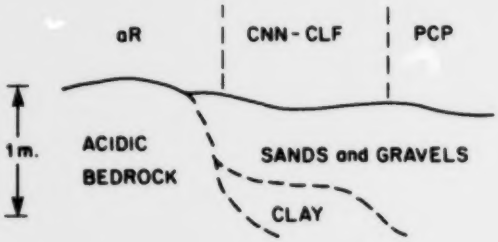
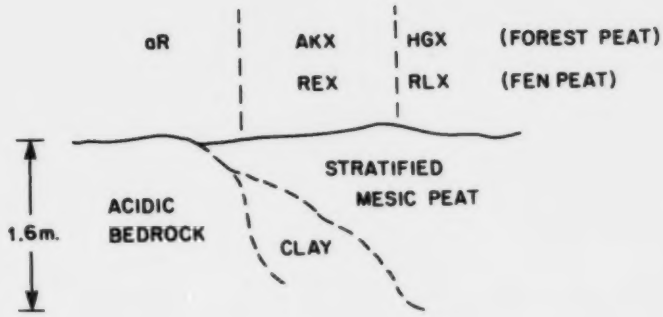



Figure 5 Relationships Between Surface Deposits And Soil Series.

Bedrock - Organic Deposits
- Organic deposits often occur as small isolated units in bedrock depressions and channels. Clay and water worked deposits are also common in bedrock depressions, underlying these organic materials.



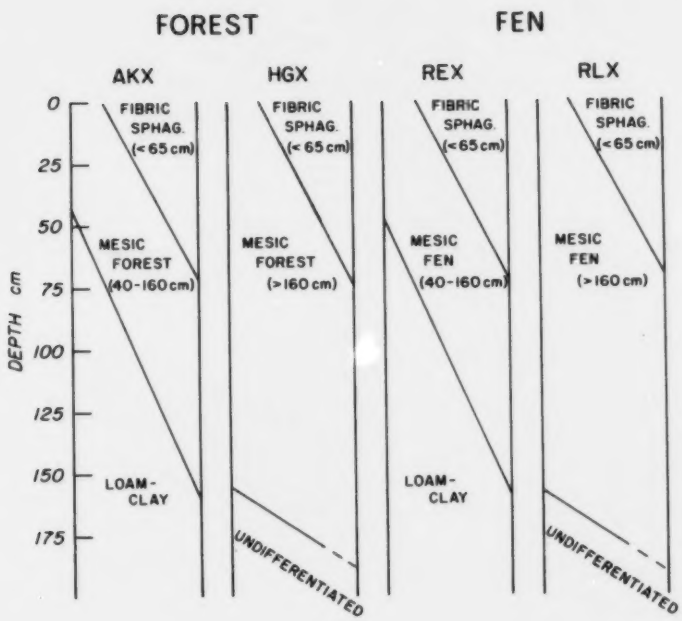




Figure 5 cont. Soils Derived From Forest And Fen Materials Were Differentiated On The Type,Depth And Degree Of Composition.

Table 5. Parent Materials, Soils and Their Estimated Extent in Flin Flon Study

| | Map Symbol | Total Ha | % of Mapped Area |
|---|---|---|---|
| A. Soils developed on Glacial Till | | | |
| 1. Deep (greater than 1 meter), non-calcareous sandy loam textured till derived from Precambrian granitic and volcanic rocks | | | |
| a) Well to moderately well drained | | | |
| Fay Lake Series (Eluviated Dystric Brunisol) | FYK | 62.31 | 1.36 |
| 2. Shallow (less than 1 meter) non-calcareous sandy loam textured till derived from Precambrian granitic and volcanic rocks overlying acidic Precambrian bedrock. | | | |
| a) Well to moderately well drained | | | |
| Wolverton Series (Eluviated Dystric Brunisol) | WVT | 198.14 | 4.30 |
| B. Soils developed on Lacustrine Clay | | | |
| 1. Deep (greater than 1 meter), weakly to moderately calcareous lacustrine clay | | | |
| a) Well to moderately well drained | | | |
| Wabowden Series (Solonetzic Gray Luvisol) | WBW | 260.98 | 5.68 |
| Sipiwesk Series (Orthic Gray Luvisol) | SWK | 108.01 | 2.35 |
| b) Imperfectly Drained | | | |
| Roe Lake Series (Gleyed Orthic Gray Luvisol) | ROK | 84.75 | 1.84 |
| c) Poorly Drained | | | |
| Medard Series (Rego Gleysol) | MDR | 146.10 | 3.10 |
| C. Soils developed on Outwash Sands and Gravels | | | |
| 1. Deep (greater than 1 meter), non-calcareous, moderately stony, stratified sands and gravels. | | | |
| a) Well Drained | | | |
| Partridge Crop Series (Eluviated Dystric Brunisol) | PCP | 80.15 | 1.74 |
| 2. Shallow (less than 1 meter), non-calcareous sands and gravels overlying weakly to moderately calcareous lacustrine clay. | | | |
| a) Well to Moderately Well Drained | | | |
| Channing Series (Eluviated Dystric Brunisol) | CNN | 13.42 | 0.29 |
| b) Imperfect to Somewhat Poorly Drained | | | |
| Cliff Series (Gleyed Eluviated Dystric Brunisol) | CLF | 46.22 | 1.01 |
| D. Very Thin (0-10 cm), variable textured mineral and organic materials overlying Precambrian bedrock. | | | |
| a) Rapidly Drained | | | |
| Rock Outcrop | aR | 1947.51 | 42.35 |

Table 5 (cont'd)

| | Map Symbol | Total Ha | % of Mapped Area |
|---|---|---|---|
| E. Soils developed on Peat Deposits | | | |
| 1. Deep (greater than 160 cm) mesic forest peat or thin (0-65 cm) fibric sphagnum peat overlying mesic forest peat underlain by lacustrine clay. | | | |
| a) Poorly to Very Poorly Drained Hargrave Complex (Typic Mesisol* and Mesic Fibrisol) | HGX | 251.86 | 5.48 |
| 2. Shallow (40 to 160 cm) mesic forest peat or thin (0-65 cm) fibric sphagnum peat overlying mesic forest peat, underlain by moderately calcareous, loamy to clayey stone-free lacustrine clay. | | | |
| a) Poorly to Very Poorly Drained Atik Complex (Terric Fibric Mesisol*, Terric Mesic Fibrisol) | AKX | 221.00 | 4.81 |
| 3. Deep (greater than 160 cm) mesic fen peat or thin (0-65 cm) fibric sphagnum peat overlying mesic fen, underlain by lacustrine clay. | | | |
| a) Poorly to Very Poorly Drained Rock Island Complex (Typic Mesisol) | RLX | 221.34 | 4.81 |
| 4. Shallow (40-60 cm) mesic fen peat or thin (0-65 cm) fibric sphagnum peat overlying mesic fen peat underlain by moderately calcareous, loamy to clayey stone-free lacustrine clay. | | | |
| a) Poorly to Very Poorly Drained Reed Lake Complex (Terric Mesisol* and Terric Fibric Mesisol) | REX | 56.31 | 1.22 |

* Dominant Soil Series

Figure 6a. Hummocky Bedrock (aR) Unit with minor shallow and some deep organic soils (AKX and HGX). Sometimes mapped separately if feasible or otherwise mapped as Complex.

Figure 6b. Gently Sloping Bedrock (aR) Unit with minor, very shallow organic soil inclusions which cannot be shown on map.

## Atik Complex (AKX)

The Atik Complex consists of poorly drained Terric Mesisols developed on weakly acidic, shallow (40-160 cm), forest peat overlying weakly calcareous, clayey lacustrine sediments. These soils occur on horizontal and veneer bogs, have moderately slow permeability in the substate and a very high (.26m) water table. The native vegetation often comprises dominantly black spruce and significant tamarack; some aspen may also occur. Dominant shrubs are usually alder, willow and ericaceous shrubs. Feathermosses are the dominant herbaceous plants.

In a representative profile of Atik Complex, the peat is generally 60-120 cm thick. The profile is characterized by an OF (30-60 cm thick) horizon overlying a 40-80 cm thick Om horizon, and a Cg horizon. The organic parent material is typically fibric over mesic. The mineral substrate is typically a neutral dark grey colored lacustrine clay.

Atik soils occur in close association with Medard soils. They are similar to Reed Lake soils by having a fibric sphagnum surface tier, and clay textured substrate, but differ from Reed Lake soils in having a mesic forest peat layer instead of mesic fen peat overlying the mineral lacustrine substrate. Atik Complex correlate with Atik Complex mapped and described in the previously published Cormorant Lake soil report.

In the Flin Flon area the clay substrate is less calcareous. Atik Complex may overlie loamy to clayey till in some areas.

In this study Atik soils also vary slightly from the norm in that its organic parent material is less fibrous (or more decomposed) and has been mapped as a classification variant. Atik Complex sometimes occur in seepage areas.

## Cliff Series (CLF)

The Cliff series consists of imperfect to poorly drained Gleyed Dystric Brunisol soils developed on a mantle (50 to 100 cm) of sandy, stratified, slightly acidic, fluvial deposits overlying weakly calcareous clayey lacustrine deposits. These soils occur in depressional positions of very gently sloping to level landscapes and have slow permeability in the subsoil, slow surface runoff and a high (<.5m) water table during the growing season. Cliff soils are non eroded, non to slightly stony and non saline. They have low available water holding capacity, low organic matter content, and low natural fertility. Native vegetation often includes black spruce, willow, Labrador tea, horsetail and some birch. The majority of these soils are currently not used and remain under natural conditions. Cliff soils are common in abandoned flow channels which connected present dry lakes during former periods of very high water levels.

In a representative profile of Cliff soil the solum is approximately 22 cm thick. The profile is characterized by a Black to Dark Brown LH horizon, 10 to 20 cm thick, a Dark Brown Bmgj horizon, 2 to 20 cm thick with few, fine, distinct mottles, a brown transitional BC horizon, 5 to 15 cm thick overlying a Dark Gray, clayey IICkg horizon with few, prominent reddish brown mottles. The parent material typically contains coarse fragments throughout. A typical profile also contains some carbonates in the lower clay deposits.

Cliff soils occur in close association with Channing soils. They are

similar to Channing soils by having similar parent materials but differ from them in having faint to distinct reddish brown mottles indicative of periodic gleying conditions. Cliff soils were previously mapped as inclusions of Partridge Crop soils in the Cormorant Lake report which was at a much smaller scale.

An example profile of a Cliff soil is presented in Appendix D.

**Channing Series (CNN)**

The Channing series consists of well drained Eluviated Dystric Brunisol soils developed on a mantle (50 to 100 cm) of medium acidic sandy, fluvial deposits overlying fine loamy to clayey, weakly calcareous lacustrine deposits (Figure 7). These soils occur in lower positions of strong to steep slopes on hummocky bedrock landscapes and have restricted permeability and moderately slow surface runoff. The underlying clay may restrict drainage although no free water or mottles were observed in the profiles. Channing soils are susceptible to erosion if exposed, non to slightly stony and non saline. They have low available water holding capacity, low organic matter content, and low natural fertility Native vegetation often includes white spruce, some aspen and ground shrubs. The majority of these soils are currently not used and remain under natural conditions.

In a representative profile of Channing soil the solum is approximately 55 cm thick. The profile is characterized by a very dark brown LH horizon, 3 to 4 cm thick, a brownish, strongly acidic, structureless Ae horizon, 2 to 12 cm thick, a dark yellowish brown Bm horizon, 35 to 45 cm thick with gravelly coarse fragments and a pale brown, medium acidic, sandy C horizon 15 to 25 cm thick, overlying a weakly acidic, brown clayey IIC horizon. The parent material is typically coarse sandy fluvial over lacustrine clay.

Channing soils occur in close association with Partridge Crop and Cliff soils. They are similar to Partridge Crop soils by having similar drainage and surface texture but differ from Partridge Crop soils because of thickness of fluvial deposits. Channing soils have a clay substrate within 1 meter depth. Channing soils were previously mapped as inclusions with Partridge Crop soils in the Cormorant Lake report.

An example profile of a Channing soil is presented in Appendix D.

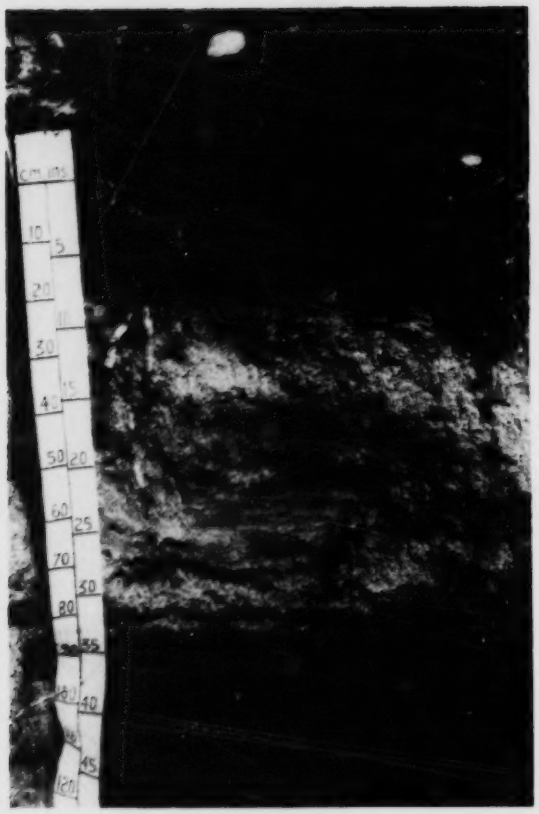


Figure 7. Channing Series (CNN) loamy sand and sand overlying clay (see 1980 Profile No. 70, Appendix D).

**Fay Lake Series (FYK)**

The Fay Lake series consists of well drained Eluviated Dystric Brunisol soils developed on a mantle of very strongly to strongly acid, coarse loamy, morainal till deposits. These soils occur in mid slope positions of strong to steep slopes on hummocky landscapes and have moderately high permeability and moderately slow surface runoff and a low water table during the growing season. Fay Lake soils are susceptible to erosion, moderately stony and non saline. They have low available water holding capacity, medium organic matter content, and low natural fertility. Native vegetation often includes white spruce, aspen, and alder with minor occurrences of birch and black spruce. The majority of these soils are currently not used and remain under natural conditions.

In a representative profile of Fay Lake soil the solum is approximately 60 cm thick. The profile is characterized by a very dark brown LH horizon, 2 to 3 cm thick, a gray structureless Ae horizon, 10 to 38 cm thick with many roots and coarse mineral fragments, a yellowish brown moderately porous Bm horizon, 30 to 45 cm thick and a light brownish gray C horizon. The parent material is typically loamy sand to gravelly sandy loam. A typical profile also contains coarse fragments throughout the profile.

Fay Lake soils occur in close association with Wolverton soils. They are similar to Wolverton soils by having similar texture, drainage and parent material but differ from them in that depth of parent material to bedrock exceeds 1 meter. Fay Lake soils were previously mapped in the Cormorant Lake soil report.

An example profile of a Fay Lake soil is presented in Appendix D.

**Hargrave Complex (HGX)**

The Hargrave Complex consists of very poorly drained Typic Mesisol soils developed on extremely acidic, sphagnum peat overlying extremely acidic moderately decomposed forest peat. These soils occur in former glacial drainage channels and depressions in the bedrock, primarily in the eastern half of the study area. They have moderate permeability and a very high (.18 m) water table. The native vegetation often comprises black spruce, tamarack, Chamaedaphne Chalcyculata (leatherleaf), willow, Labrador Tea, ericaceous shrubs, short white spruce, swamp birch, and grasses with minor occurrences of Equisetum (horsetail), and alder.

In a representative profile of the Hargrave Complex, the peat is generally 165 to 410 cm thick. The profile is characterized by an Of (20 to 70 cm thick) horizon overlying an Om (130 to 280 cm thick) middle tier on an Oh (20 to 70 cm thick) bottom tier. The organic parent material is typically fibric over mesic and then humic with clay textures dominating the mineral substrate.

Hargrave soils occur primarily in channels and depressions in the bedrock predominantly in the east half of the map area. They are similar to Atik soils in materials and composition, but differ from Atik soils because of the deeper layer of peat overlying clay (>160 cm). Hargrave soils correlate with the Hargrave Complexes previously published in the Cormorant Lake interim soil report.

## Medard Series (MDR)

The Medard series consists of poorly drained Rego Gleysol soil developed on weakly to moderately calcareous, uniform deep clayey lacustrine deposits. Occasionally, thin interstratified layers of organic materials are found in the profile. These soils occur in depressional positions of nearly level landscapes and have very slow permeability, very slow surface runoff and a high water table during the growing season. Medard soils are non eroded, non stony and non saline. They have high available water holding capacity, medium to high organic matter content, and medium natural fertility. Native vegetation often includes black spruce, willow, Labrador tea, alder, horsetail and sedges. The majority of these soils are currently not used and remain in their natural conditions.

In a representative profile of Medard soil the solum is approximately 40 cm thick. The profile is characterized by a peaty Om horizon, 15 to 35 cm thick, overlying a more decomposed dark brown to black Oh horizon, 2 to 10 cm thick with some mineral inclusions, a dark grayish brown Cg horizon, 10 to 50 cm thick with common coarse prominent mottles. The parent material is typically gray to olive gray clay with mottles. A typical profile also contains a few coarse fragments in the C horizon.

Medard soils occur in close association with Roe Lake, Atik and Reed Lake soils. When they are associated with the last two, Medard soils invariably have a peaty surface horizon. Medard soils were previously mapped as Medard in the Cormorant Lake report.

An example profile of a Medard soil is presented in Appendix D.

## Partridge Crop Series (PCP)

The Partridge Crop series consists of well drained Eluviated Dystric Brunisol soil developed on very strongly acidic, stratified, fluvial deposits more than 1 meter in thickness (Figure 8a). These soils occur in upper positions of steep slopes on hummocky landscapes and have rapid permeability and slow surface runoff. Partridge Crop soils are non eroded, and moderately stony (Figure 8b). They have low available water holding capacity, low organic matter content, and low natural fertility. Native vegetation often includes mixed coniferous and hardwood species such as black spruce, jack pine, aspen, and birch. Shrubs consist of dogwood and ericaceous types. Herbaceous plants consist of bunchberry, feathermosses, sedges and grass species. The majority of these soils are currently used for gravel and aggregate source areas if accessible.

In a representative profile of Partridge Crop soil the solum is approximately 38 cm thick. The profile is characterized by thin very dark grayish brown LFH horizon, 2 to 10 cm thick, with abundant fine and medium roots, a brown, structureless Ae horizon, 1 to 6 cm thick with about 60% coarse fragments, a dark yellowish brown Bm horizon, 10 to 35 cm thick with loose single grain structure, and a yellowish brown single grained C horizon. A typical profile also contains stones, cobbles and coarse fragments throughout.

Partridge Crop soils occur in close association with Channing and Clarke soils. They are similar to Channing soils by having similar drainage and parent material but differ from Channing soils because of their deeper depth of fluvial sediments. Channing soils are underlain by clay within 1 meter depth. Partridge Crop soils are more gravelly than Clarke soils. Partridge Crop

soils were previously mapped as Clarke soils in the Cormorant Lake report.

An example profile of a Partridge Crop soil is presented in Appendix D.

Figure 8a. Partridge Crop Series, Eluviated Dystric Brunisol, developed on outwash sands and gravels, usually on strongly sloping landscapes overlying bedrock (see 1981 Profile No. 54, Appendix D).

Figure 8b. Partridge Crop Series, moderately stony, deeper deposits on lower slopes (see 1981 Profile No. 56, Appendix D).

**Reed Lake Complex (REX)**

The Reed Lake Complex consists of very poorly drained Terric Mesisol soils developed on weak to moderately acidic, shallow (50 to 100 cm thick), uniform, fen peat overlying neutral to weakly acidic, uniform, clayey lacustrine deposits. These soils occur in depressions in horizontal fens, have moderate to slow permeability due to the lacustrine clay substrate and also because of very high (.1 m) water table overlying the clay. The native vegetation is normally comprised of fen type vegetation such as sedges, reed grasses, willow and alder groves. Stunted black spruce and tamarack may also encroach from slightly better drained wooded fringe areas. The majority of these soil areas exist as unused wetlands.

In a representative profile of the Reed Lake Complex, the peat is generally 50 to 100 cm thick. The profile is characterized by a dark brown fibric Of (10 to 40 cm thick) horizon overlying a very dark brown mesic Om (30 to 85 cm thick) horizon, and a black to very dark olive grey, mildly acidic, massive structured clayey Cg horizon. The dark grey color is indicative of strong gleying conditions.

Reed Lake Complexes occur in close association with the Rock Island Complex. These complexes have similar organic parent material, but differ in their depth to mineral soils, the Rock Island Complex being much deeper than the Reed Lake (Typic vs Terric Mesisols). Reed Lake Complex correlates with the Reed Lake Complex described in the previously published Cormorant Lake interim soil report. In the Flin Flon area, the clay substrate lacks carbonates.

A representative profile of this soil is presented in Appendix D.

**Rock Island Complex (RLX)**

The Rock Island Complex consists of very poorly drained Typic Mesisol soils developed on deep (>165 cm) strongly acidic, uniform, fen peat overlying neutral to weakly acidic, uniform, clayey lacustrine sediments. These soils occur in bedrock depressions as horizontal fens (Figure 9a) and have decreasing permeability with increasing depth, and a very high (.25 m) water table. Occasionally, open pools of water occur in the central portions (Figure 9b). The native vegetation is comprised of fen type vegetation such as sedges, reed grasses with groves of dwarfed bog birch, paper birch, Labrador tea. Stunted black spruce, tamarack, alder and other shrubs encroach from wooded fringe areas. The majority of these soils occur as unused wetlands.

In a representative profile of a Rock Island Complex, the peat is generally 165 to 500 cm thick. The profile is characterized by a dark yellowish brown fibric Of (5 to 40 cm thick) surface tier, overlying a very dark brown, strongly acidic mesic Om (130 to 300 cm thick) organic horizon. A very dark grayish brown, massive structured, acidic humified Oh horizon occurs above the clay mineral substrate.

Rock Island soils occur in close association with Reed Lake soils. They are similar to Reed Lake Complexes by having the same organic material composition, but differ from them in thickness to underlying clay. Reed Lake soils contain clay within 1.2 m depth. Rock Island Complex correlate with Rock Island Complex described in the previously published Cormorant Lake interim soil report.

In this study, some of the deeper Rock Island soils vary slightly from the norm in having significantly thick, more strongly decomposed black

colored humic horizons occur between the mesic middle tier and the clayey mineral soil substrate.

A representative soil profile of this soil complex is presented in Appendix D.

Figure 9a. Rock Island Complex (RLX) in Bedrock Depression.

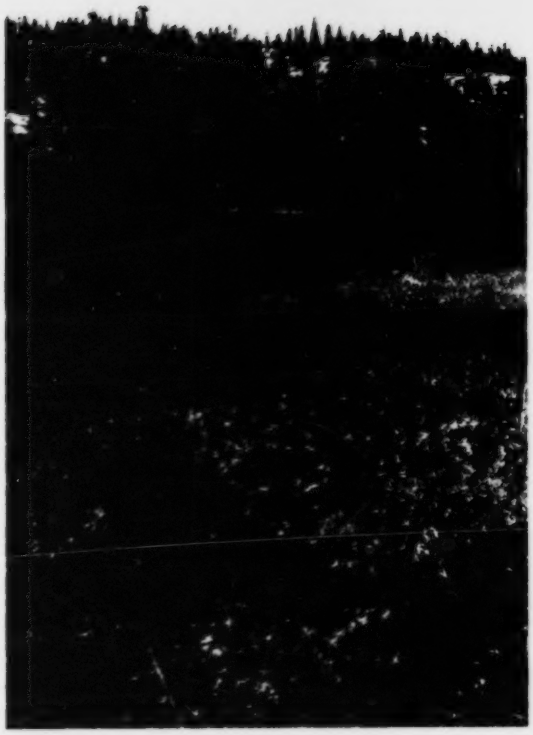


Figure 9b. Rock Island Complex (RLX) with Occasional Pools of Open Water.

## Roe Lake Series (ROK)

The Roe Lake series consists of imperfectly drained Gleyed Gray Luvisol soils developed on weakly to moderately calcareous, deep uniform, clayey lacustrine deposits. These soils occur in lower positions of gently sloping to level landscapes and have slow permeability, slow surface runoff and a medium high (approx. 1 m) water table during the growing season. Roe Lake soils have high available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes black spruce, jack pine, aspen, and dogwood, along with sedges and grasses. The majority of these soils are currently not used and remain in their natural states.

In a representative profile of Roe Lake soil the solum is approximately 50 cm thick. The profile is characterized by a very dark brown LH horizon, 2 to 10 cm thick, a light gray to gray loamy textured platy structured Ae horizon, 10 to 20 cm thick, a clayey prismatic AB horizon, 10 to 15 cm thick and a dark brown blocky structured, clayey Bt horizon, 20 to 35 cm thick. The underlying 15 to 30 cm thick BC horizon is usually dark grayish brown blocky structured and clayey textured.

The parent material is typically clay textured, calcareous, massive structured and usually dark gray in color indicative of gleying conditions. A typical profile also contains reddish brown mottles in all mineral horizons.

Roe Lake soils occur in close association with the more well drained Sipiwesk and more poorly drained Medard soils. Roe Lake soils were previously mapped and described in the Cormorant Lake interim soil report.

## Sipiwesk Series (SWK)

The Sipiwesk series consists of well drained Orthic Gray Luvisol soils developed on weakly to moderately calcareous, clayey deep lacustrine deposits. These soils occur in middle and upper positions of moderate slopes on hummocky to level landscapes and have slow permeability and moderate surface runoff. Sipiwesk soils are prone to erosion if unprotected, non stony and non saline. They have high available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes mixed coniferous and hardwood forest species, white spruce, aspen, jack pine, alder with minor amounts of birch, horsetail and willow. The majority of these soils are currently not used and remain under natrual woodland.

In a representative profile of Sipiwesk soil the solum is approximately 60 cm thick. The profile is characterized by very dark brown, acidic LH horizon, 5 to 20 cm thick, a light gray, platy structured, loamy Ae horizon, 15 to 30 cm thick with an underlying transitional AB horizon grading to a dark brown, clay textured, strong medium angular blocky structured Bt horizon, 30 to 50 cm thick, and a dark grayish brown BC horizon, 15 to 25 cm thick. The parent material is typically calcareous dark gray clay.

Sipiwesk soils occur in close association with clayey textured more poorly structured Wabowden soils and the imperfectly drained Roe Lake soils. They differ from Wabowden soils because of their more subangular blocky to granular structure. Wabowden soils have very hard, strongly developed, coarse columnar structures in their AB and Bt horizons. Sipiwesk soils were previously mapped and described in the Cormorant Lake report. However, the clayey

sediments in the Flin Flon area appear to be less calcareous than those in the Cormorant Lake area.

An example profile of a Sipiwesk soil is presented in Appendix D.

**Wabowden Series (WBW)**

The Wabowden series consists of well drained Solonetzic Gray Luvisol soils developed on weakly to moderately calcareous, deep, uniform clayey lacustrine deposits (Figure 10). These soils occur in midslope positions of undulating to hummocky landscapes and have slow permeability and moderate surface runoff. Wabowden soils are seldom eroded, non stony and non saline. They have high available water holding capacity, medium organic matter content, and medium natural fertility. Native vegetation often includes white poplar, white and black spruce, alder. The majority of Wabowden soil areas exist as unused productive woodland.

In a representative profile of Wabowden soil the solum is approximately 70 cm thick. The profile is characterized by a very dark brown, acidic LH horizon, 8 to 15 cm thick, a dark grayish brown, platy structured loamy, acidic Ae horizon, 10 to 15 cm thick overlying a 10 to 20 cm thick transitional AB horizon, a dark grayish brown acidic Bt horizon, 25 to 35 cm thick with well developed columnar structure, a BC horizon, 15 to 25 cm thick and a clayey C horizon. The parent material is typically dark gray in color and weakly calcareous with very thin lenses of very fine sand and silt. A typical profile also contains a few coarse fragments.

Wabowden soils occur in close association with clayey granular subangular blocky structured Sipiwesk soils. They are similar to Sipiwesk soils by having clayey parent material and good soil drainage, but differ from them in having strongly developed coarse round topped columns in their AB and B horizons. Wabowden soils were previously mapped as Wabowden soils as described in the Cormorant Lake interim soils report.

An example profile of a moderately well drained Wabowden soil is presented in Appendix D.

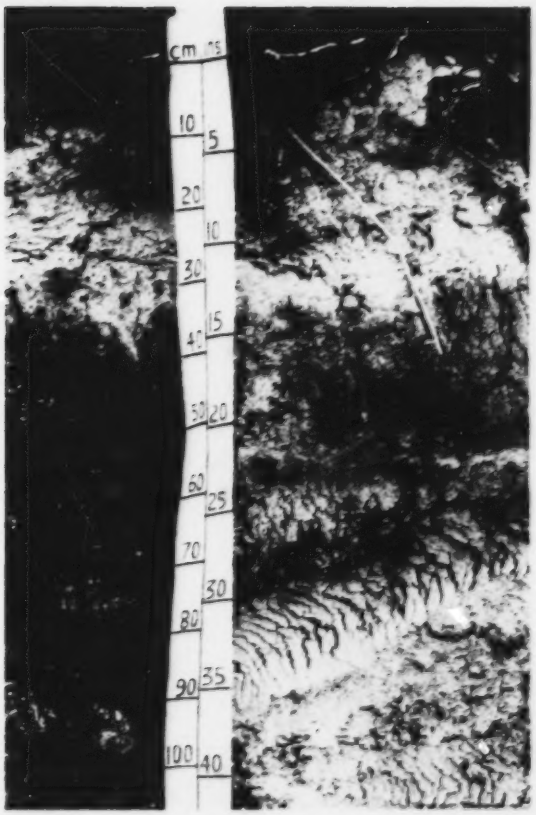



Figure 10. Wabowden Series, Solonetzic Grey Luvisol, developed in deep, slightly to strongly calcareous lacustrine clay.

**Wolverton Series (WVT)**

The Wolverton series consists of well drained Eluviated Dystric Brunisol soils developed on a mantle (10 to 100 cm) of very strongly acid sandy morainal deposits overlying Precambrian bedrock (Figures 11a & b). These soils occur in upper slope and crest positions of moderately to strongly sloping bedrock landscapes. They have moderate permeability and slow to moderate surface runoff. Wolverton soils are moderately susceptible to erosion if unprotected and very stony. They have low available water holding capacity, low organic matter content, and low natural fertility. Native vegetation often includes white spruce, jack pine, birch, aspen, alder. The majority of Wolverton soil areas are currently unused uplands.

In a representative profile of Wolverton soil the solum is approximately 16 cm thick. The profile is characterized by a very strongly acidic dark brown LH or LFH horizon, 4 to 10 cm thick, a thin broken gray colored Ae horizon, 3 to 7 cm thick, a brown to dark yellowish brown, sandy Bm horizon, 10 to 20 cm thick and a pale brown acidic C horizon. The parent material is typically derived from acidic bedrock. A typical profile contains bedrock at about 20 to 50 cm and has coarse fragments throughout the profile. Wolverton soils occur in close association with Fay Lake soils and bedrock outcrops. They are similar to Fay Lake soils by having similar drainage and parent material but differ from Fay Lake soils because of their shallow depth to bedrock. Wolverton soils were previously mapped as Wolverton Series in the Cormorant Lake interim soil report.

An example profile of a Wolverton soil is presented in Appendix D.

Figure 11a. Wolverton Series (WVT), Orthic Dystric Brunisol developed on shallow sandy loam to loamy sand deposits overlying acidic bedrock. Deeper profile in bedrock crevass (see 1980 Profile No. 74, Appendix D).

Figure 11b. Wolverton Series, very shallow phase on bedrock (see 1981, Profile No. 61, Appendix D).

## 3.2 SOIL EROSION POTENTIAL

No evidence of erosion was observed during the field survey. This was due to the dense natural vegetative cover that occured on nearly all of the mineral soils. Some soils, however, are susceptible to erosion. Sipiwesk and Wabowden soils are highly erodible due to the high silt content in their surface horizons (see K factors, Table 6). This means that there is a high risk of water erosion if the vegetative cover on these soils is removed for gardening, construction, or road building. The severity of erosion depends on the slope length and gradient of the exposed surface. Steeply sloping road cuts and fills, especially those through Sipiwesk and Wabowden soils should be stabilized as soon as possible to prevent water erosion which can deposit excessive sediment in ditches and natural drains.

Table 6. Soil Erodibility - K Factors for Some Soils in the Flin Flon Study Area

| Soil Series | 1 % Si + VFS | 2 % FS + MS + CS | % Org. Matter | 3 Structural Class | 4 Profile Perm. Class | 5 K Factor |
|---|---|---|---|---|---|---|
| Channing | 22 | 78 | 1.2 | 1 | 3 | .10 |
| Cliff | 21 | 29 | 11.08 | 1 | 3 | .08 |
| Fay Lake | 31 | 61 | 2.80 | 2 | 3 | .15 |
| Partridge Crop | 21 | 75 | 2.21 | 1 | 1 | .05 |
| Partridge Crop | 33 | 46 | 2.48 | 1 | 1 | .08 |
| Sipiwesk | 46 | 48 | 0.22 | 4 | 4 | .43 |
| Wabowden | 42 | 16 | 3.10 | 4 | 5 | .28 |
| Wolverton | 37 | 54 | 2.80 | 1 | 3 | .17 |
| Wolverton | 33 | 57 | 3.86 | 1 | 3 | .13 |

[1] % Si + VFS (.002-.1 mm)

[2] % Sand (.1-2 mm)

[3] Structure

| Class | Description |
|---|---|
| 1 | very fine granular, structureless, single grain |
| 2 | fine granular |
| 3 | med. or coarse granular |
| 4 | blocky, platy, or massive |

[4] Profile Permeability

| | |
|---|---|
| 1 | rapid |
| 2 | moderate to rapid |
| 3 | moderate |
| 4 | slow to moderate |
| 5 | slow |
| 6 | very slow |

[5] Estimated from the Soil-Erodibility Nomograph (Figure 12)

* Organic Matter % = Organic Carbon % x 1.71

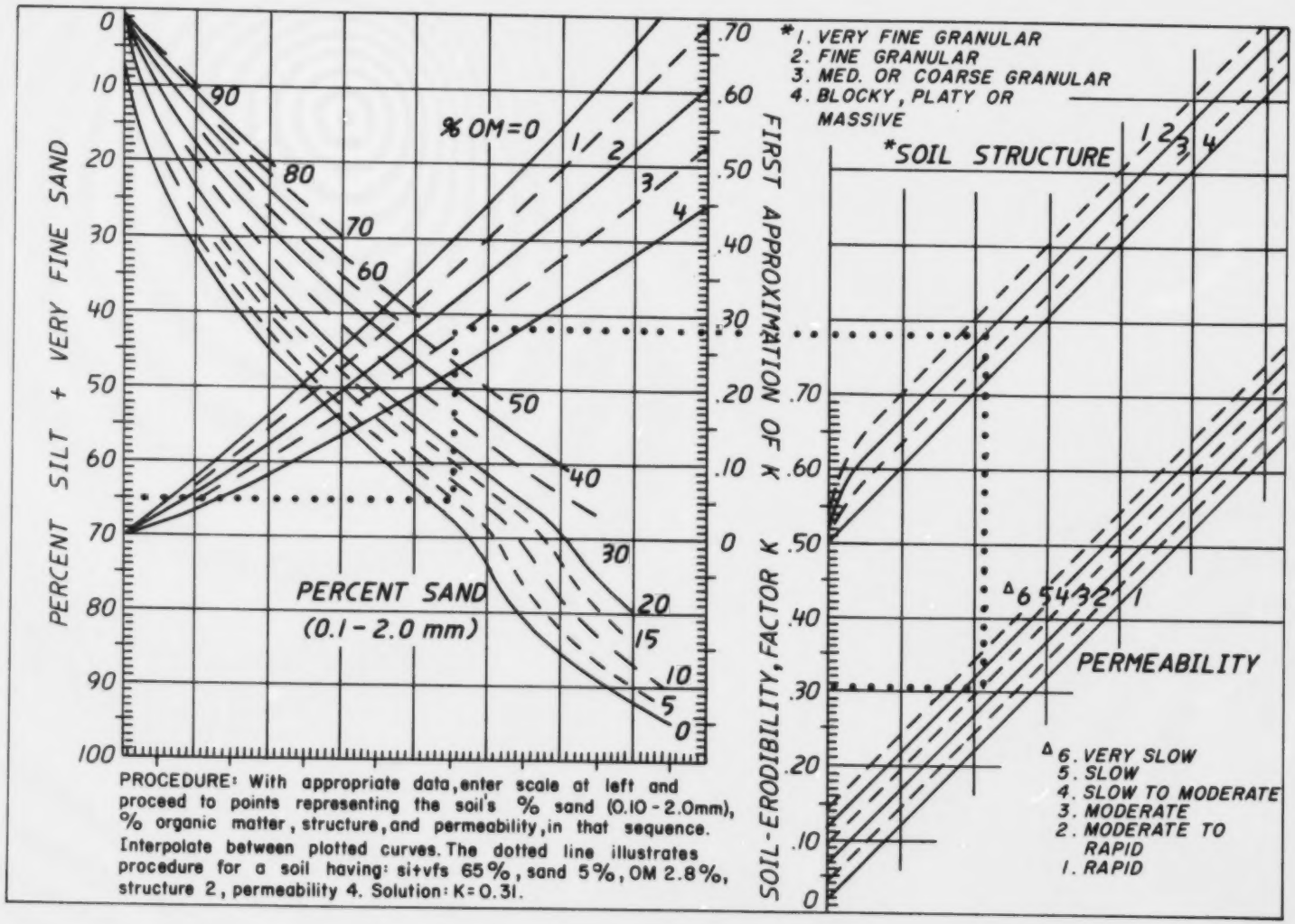



**Figure 12:** Soil Erodibility Nomograph.

## PART 4

## USE AND MANAGEMENT INTERPRETATIONS OF SOILS

### 4.1 INTRODUCTION

This section provides predictions of performance or soil suitability ratings for various uses of soils based on field observations of soil and landscape characteristics, laboratory data, and on observations of soil behaviour under specified conditions of land use and management. Suitability ratings or interpretations are intended only to serve as guides for planners and managers. Caution, with an understanding of the limitations of the soil map must be exercised when applying suitability ratings to soil map units. The value of any rating or interpretation depends upon the nature and composition of individual map unit delineations which in turn depends on the scale of mapping and intensity of ground truthing employed in the survey.

In this section, interpretive soil information is provided for the following land-use evaluations:

1. Agriculture

   a) dryland farming capability

2. Engineering Uses

3. Recreation Uses

### 4.2 AGRICULTURAL CAPABILITY EVALUATION

#### Climatic Conditions for Crop Production

Regional climatic conditions for the Flin Flon Study Area provide a moderately severe limitation (Class 3H) to agriculture (Mills 1980)[11]. Thus, the potential to grow agricultural crops in this region is moderate to nil (Smith 1980)[12]. The average length of frost free season is less than 90 days; growing degree days above 5.5 degrees C from May 1 to September 30 is approximately 1000, and the mean summer soil temperatures (50 cm) are less than 6 degrees C (Mills 1980). Root crops, garden vegetables and small fruits are grown in protected areas for private and local use.

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[11] Mills. G.F. 1980. Climatic Limitations for Agricultural Land Evaluation in Manitoba. Canada-Manitoba Soil Survey, Dept. of Soil Science, University of Manitoba. Proceedings of the Manitoba Soil Science Society.

[12] Smith, R.E. 1980. Additional Land for Crop Production in Manitoba. Proceedings of Manitoba Soil Science Society.

### Soil Conditions for Crop Production

Soil conditions in the study area are even more restrictive than climate. Bedrock outcrops, stoniness, excessive wetness, and shallow organic soils severely limit the potential even to grow domestic garden crops. Sipiwesk soils would have the least limitation for gardening. However, only 108 hectares were mapped and their occurrence is generally isolated. Wabowden soils have a poor structure that limits their suitability for gardening. Roe Lake soils are imperfectly drained, and Medard soils are excessively wet.

Partridge Crop and Fay Lake soils are coarse textured and stony; Wolverton soils are similar to Fay Lake soils but are also shallow to bedrock.

## 4.3 SOIL CAPABILITY FOR AGRICULTURE

### Dryland Agriculture

Soil capability classification for dryland agriculture is based on evaluation of both internal and external soil characteristics that influence soil suitability and limitations for agricultural use. In this classification, mineral soils are grouped into capability classes and subclasses based on their limitations for dryland farming, risk of damage when the soils are used and the way they respond to management[13]. There are seven capability classes, each of which groups soils together that have the same relative degree of limitation or hazard for agricultural use. The limitation becomes progressively greater from Class 1 to Class 7. The class indicates the general suitability of the soils for agriculture. The first three classes are considered capable of sustained production of common field crops, the fourth is marginal for sustained arable culture, the fifth is suitable only for improved permanent pasture, the sixth is capable of use only for native pasture while the seventh class is for soils and land types considered incapable of use for arable agriculture or permanent pasture (see definitions, Appendix E).

[13] ARDA. 1965. Land capability classification for agriculture Report No. 2 Canada Land Inventory, Canada Dept. Regional Economic Expansion, Ottawa. 16 pp.

Organic soils within the map area are rated for "potential" agricultural capability after the method of Leeson[14]. Capability ratings of organic soils for agriculture must recognize that most organic soils have little or no value for agriculture in their native state and their potential is only achieved through reclamation or development implemented with varying degrees of difficulty. Capability class definitions for organic soils are the same as for mineral soils. They are however identified on maps and tables with the prefix "O".

Soil capability subclasses are divisions within classes which group soils with similar kinds of limitations and hazards for agricultural use. The various kinds of limitations recognized at the subclass level are defined in Table 7.

A summary of the soils in the Flin Flon area showing their major characteristics and their interpretive classification for dryland agriculture is presented in Table 8.

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[14] Leeson, Bruce et al 1969. An organic soil capability classification for agriculture and a study of the organic soils of Simcoe County, Soil Sci. Dept., Ontario Agricultural College, Guelph, Ontario.

TABLE 7

Agricultural Capability Subclass Limitations

C- Adverse climate: This subclass denotes a significant adverse climate for crop production as compared to the "median" climate which is defined as one with sufficiently high growing-season temperatures to bring field crops to maturity, and with sufficient precipitation to permit crops to be grown each year on the same land without a serious risk of partial or total crop failures.

D- Undesirable soil structure and/or low permeability: This subclass is used for soils difficult to till, or which absorb water very slowly or in which the depth of rooting zone is restricted by conditions other than a high water table or consolidated bedrock.

E- Erosion: Subclass E includes soils where damage from erosion is a limitation to agricultural use. Damage is assessed on the loss of productivity and on the difficulties in farming land with gullies.

F- Low fertility: This subclass is made up of soils having low fertility that either is correctable with careful management in the use of fertilizers and soil amendments or is difficult to correct in a feasible way. The limitation may be due to lack of available plant nutrients, high acidity or alkalinity, low exchange capacity, high levels of carbonates or presence of toxic compounds.

I- Inundation by streams or lakes: This subclass includes soils subjected to inundation causing crop damage or restricting agricultural use.

L- Coarse wood fragments: In the rating of organic soils, woody inclusions in the form of trunks, stumps and branches (>10 cm diameter) in sufficient quantity to significantly hinder tillage, planting and harvesting operations.

M- Moisture limitation: This subclass consists of soils where crops are adversely affected by droughtiness owing to inherent soil characteristics. They are usually soils with low water-holding capacity.

N- Salinity: Designates soils which are adversely affected by the presence of soluble salts.

P- Stoniness: This subclass is made up of soils sufficiently stony to significantly hinder tillage, planting, and harvesting operations. Stony soils are usually less productive than comparable non-stony soils.

R- Consolidated bedrock: This subclass includes soils where the presence of bedrock near the surface restricts their agricultural use. Consolidated bedrock at depths greater than 1 meter from the surface is not considered as a limitation, except on irrigated lands where a greater depth of soil is desirable.

T- Topography: This subclass is made up of soils where topography is a limitation. Both the percent of slope and the pattern or frequency of slopes in different directions are important factors in increasing the cost of farming over that of smooth land, in decreasing the uniformity of growth and maturity of crops, and in increasing the hazard of water erosion.

W- Excess water: Subclass W is made up of soils where excess water other than that brought about by inundation is a limitation to their use for agriculture. Excess water may result from inadequate soil drainage, a high water table, seepage or runoff from surrounding areas.

X- Cumulative minor adverse characteristics: This subclass is made up of soils having a moderate limitation caused by the cumulative effect of two or more adverse characteristics which singly are not serious enough to affect the class rating.

Table 8. Agriculture Capability of Soils in the Flin Flon Area

| Symbol | Soil Name | Dom. Subgroup | Agriculture Capability |
|---|---|---|---|
| AKX | Atik Complex (Organic) | T.F.M. (40-130 cm/c) | 05w |
| aR | Precambrian Bedrock | - | 7r |
| CNN | Channing (CoS-Gr/C) | E.DY.B | 4m |
| CLF | Cliff (CoS-Gr/C) | GL.E.DY.B | 4w |
| FYK | Fay Lake (SL) | E.DY.B | 5mp |
| HGX | Hargrave Complex (Organic) | TY.M (>160 cm) | 06w |
| MRD | Medard (C) | R.G. (peaty) | 6w |
| PCP | Partridge Crop (CoS-Gr) | E.DY.B | 5m |
| REX | Reed Lake Complex (Organic) | T.M. (30-130 cm/c) | 04w |
| RLX | Rock Island Complex (Organic) | TY.M (>160 cm) | 06w |
| ROK | Roe Lake (C) | GL.O.GL | 4w |
| SWK | Sipiwesk (C) | O.GL | 3c |
| WBW | Wabowden (C) | SZ.GL | 4d |
| WVT | Wolverton (SL Till/aR) | E.DY.B | 5p |

## 4.4 SOIL SUITABILITY FOR SELECTED ENGINEERING USES

This section provides information which can be used by engineers and land use planners concerned with engineering and related geotechnical aspects of soil. It is intended to supplement the information on the soil map with additional data on engineering properties of soils.

The criteria used to evaluate soil suitability for selected engineering and related recreational uses are adopted from guides found in Coen et al[15], and from guidelines developed by the Soil Conservation Service, United States Department of Agriculture[16] and the Canada Soil Survey Committee[17].

### Definition of Soil Suitability Classes

Evaluation of soil suitability for engineering and recreation uses is based on both internal and external soil characteristics. Four soil suitability classes are used to evaluate both mineral and organic soils and hence, mapping units for selected uses. These ratings express relative degrees of suitability or limitation for potential uses of natural or essentially undisturbed soils. The long-term effects of the potential use on the behaviour of the soil are considered in the rating.

The four suitability class ratings are defined as follows:

Good- Soils in their present state have few or minor limitations that would affect the proposed use. The limitations would easily be overcome with minimal cost.

Fair- Soils in their present state have one or more moderate limitations that would affect the proposed use. These moderate limitations would be overcome with special construction, design, planning or maintenance.

Poor- Soils in their present state have one or more severe limitations that would severely affect the proposed use. To overcome these severe limitations would require the removal of the limitation or difficult and costly alteration of the soil or of special design or intensive maintenance.

Very poor- Soils have one or more features so unfavourable for the proposed use that the limitation is very difficult and expensive to overcome or the soil would require such extreme alteration that the proposed use is economically impractical.

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[15] Coen et al, 1977. Soil Survey of Yoho National Park, Canada. Alberta Soil Survey Report No. 37. 208pp. Alberta Institute of Pedology, University of Alberta, Edmonton, Alberta.

[16] USDA, 1971. Guide for Interpreting Engineering Uses of Soils. Soil Conservation Service USDA. SCS-45. 87pp.

[17] CSSC, 1973. Proceedings of the Ninth Meeting of the Canada Soil Survey Committee, University of Saskatchewan, Saskatoon. 357pp.

## Soil Suitability Subclasses

The basic soil properties that singly or in combination with others commonly affect soil suitability for selected engineering properties and recreation uses are provided in Table 9. These subclass designations serve to identify the kind of limitation or hazard for a particular use. Some of these soil and landscape properties for soils mapped in this study are given in Table 10.

TABLE 9

Codes utilized to identify limitations in evaluating soil suitability for selected uses

a subgrade properties
b thickness of topsoil
c coarse fragments on surface
d depth to bedrock
e erosion or erodibility
f susceptibility to frost hazard
g contamination hazard of groundwater
h depth to seasonal water table
i flooding or inundation
j thickness of slowly permeable material
k permeability or hydraulic conductivity
l shrink-swell properties
m moisture limitations or deficit
n salinity or sulphate hazard
o organic matter
p stoniness
q depth to sand or gravel
r rockiness
s surface texture
t topographic slope class
u moist consistence
w wetness or soil drainage class
z permafrost

Table 10. Soil and Landscape Properties Used to Identify Limitations in Evaluating Soil Suitability for Selected Uses

| Soil and Landscape Properties | Symbol Codes | Atik Complex AKX | Bedrock aR | Channing Series CNN | Cliff Series CLF | Fay Lake Series FYK |
|---|---|---|---|---|---|---|
| Subgrade properties (Unifed Soil Classification) | a | Pt | NA | SP/CH | SP/CH | SC |
| Thickness of topsoil (solum - cm) | b | 40-160 | NA | 55 | 23 | 61 |
| Coarse fragments on surface (% by vol.) | c | NA | NA | <3% | <3% | 3-15% |
| Depth to bedrock (m) | d | >1 | 0 | >1 | >1 | >1 |
| Erosion (class) | e | NA | NA | Low | Low | Slight |
| Susceptibility to frost hazard | f | Moderate | NA | Low | Low | Low |
| Contamination hazard of groundwater | g | Low-Mod. | NA | Low-Mod. | Mod. | Low |
| Depth to seasonal water table (m) | h | <.5 | NA | <.5 | <.5 | >2 |
| Flooding or inundation (frequency) | i | Occasional | None | Occasional | Frequent | Rare |
| Thickness of slowly permeable material (cm) | j | NA | NA | >50 | >50 | <25 |
| Est. permeability or hydraulic conductivity (cm/hr) | k | <0.5 | NA | 5-15/ 0.5 | 5-15/ 0.5 | 1.5-5 |
| Shrink-swell properties | l | NA | NA | Low | Low | Low |
| Moisture Limitations or deficit (W.H.C.) (cm) | m | NA | NA | >7.5 | 7.5-15 | 7.5-15 |
| Salinity or sulfate hazard (mS/cm) (topsoil) | n | <1 | NA | <1 | <1 | <1 |
| Organic matter (%) | o | >40 | NA | <2 | <2 | <2 |
| Stoniness (class) | p | 0 | NA | 0 | 0 | 2 |
| Depth to sand or gravel (cm) | q | NA | NA | 0 | 0 | 0 |
| Rockiness (class) | r | 0 | 5 | 0 | 0 | 0 |
| Surface texture | s | Fibric | NA | LS | LS | SL |
| Topographic slope class | t | Level | c-j | a-b | a-b | c-f |
| Moist Consistence | u | NA | NA | Loose | Loose | Very Friable |
| Wetness or drainage class | w | P-VP | NA | W | I-P | W |
| Permafrost | z | NA | NA | NA | NA | NA |

Table 10 (cont'd)

| Soil and Landscape Properties | Symbol Codes | Hargrave Complex HGX | Medard Series MDR | Partridge Crop Series PCP | Reed Lake Complex REX | Rock Island Complex RLX |
|---|---|---|---|---|---|---|
| Subgrade properties (Unifed Soil Classification) | a | Pt | CH | GP | Pt | Pt |
| Thickness of topsoil (solum - cm) | b | 1-5m | 25 | 37 | 40-160 | 40-160 |
| Coarse fragments on surface (% by vol.) | c | NA | None | 3-15% | NA | NA |
| Depth to bedrock (m) | d | >1 | >1 | >1 | >1 | >1 |
| Erosion (class) | e | NA | Low | Low | NA | NA |
| Susceptibility to frost hazard | f | Moderate | Moderate | Low | Moderate | Moderate |
| Contamination hazard of groundwater | g | Low | Low | Mod.-High | Low-Mod. | Low-Mod. |
| Depth to seasonal water table (m) | h | <.5 | <1 | >3 | <.5 | <.5 |
| Flooding or inundation (frequency) | i | Occasional | Frequent | None | Occasional | Occasional |
| Thickness of slowly permeable material (cm) | j | NA | >100 | <25 | NA | NA |
| Est. permeability or hydraulic conductivity (cm/hr) | k | <0.5 | <0.05 | >50 | <0.5 | <0.5 |
| Shrink-swell properties | l | NA | High | Low | NA | NA |
| Moisture Limitations or deficit (W.H.C.) (cm) | m | NA | >15 | <7.5 | NA | NA |
| Salinity or sulfate hazard (mS/cm) (topsoil) | n | <1 | <1 | <1 | <1 | <1 |
| Organic matter (%) | o | >40 | >4 | <2 | >40 | >40 |
| Stoniness (class) | p | 0 | 0 | 3 | 0 | 0 |
| Depth to sand or gravel (cm) | q | NA | NA | 0 | NA | NA |
| Rockiness (class) | r | 0 | 0 | 0 | 0 | 0 |
| Surface texture | s | Fibric | C | S-Gr | Fibric | Fibric |
| Topographic slope class | t | Level | Level | c-f | Level | Level |
| Moist Consistence | u | NA | Firm | Loose | NA | NA |
| Wetness or drainage class | w | P-VP | P | W | VP-P | VP |
| Permafrost | z | NA | NA | NA | NA | NA |

Table 10 (cont'd)

| Soil and Landscape Properties | Symbol Codes | Roe Lake Series ROK | Sipiwesk Series SWK | Wabowden Series WBW | Wolverton Series WVT |
|---|---|---|---|---|---|
| Subgrade properties (Unifed Soil Classification) | a | CH | CH | CH | SC/R |
| Thickness of topsoil (solum - cm) | b | 50 | 58 | 66 | 17 |
| Coarse fragments on surface (% by vol.) | c | None | None | None | 3-15% |
| Depth to bedrock (m) | d | >1 | >1 | >1 | <1 |
| Erosion (class) | e | Moderate | High | Moderate | Slight |
| Susceptibility to frost hazard | f | Moderate | Moderate | Low | Low |
| Contamination hazard of groundwater | g | Low-Mod. | Low | Low | Low-Mod. |
| Depth to seasonal water table (m) | h | <1.5 | >1.5 | >1.5 | N/A |
| Flooding or inundation (frequency) | i | Occasional | Rare | None | None |
| Thickness of slowly permeable material (cm) | j | >100 | >100 | >100 | <25 |
| Est. permeability or hydraulic conductivity (cm/hr) | k | 0.05-0.15 | 0.15-0.5 | 0.05-0.15 | 1.5-5/<0.05 |
| Shrink-swell properties | l | High | Mod.-High | High | Low |
| Moisture Limitations or deficit (W.H.C.) (cm) | m | >15 | >15 | >15 | 7.5-15 |
| Salinity or sulfate hazard (mS/cm) (topsoil) | n | <1 | <1 | <1 | <1 |
| Organic matter (%) | o | >4 | >4 | >4 | <2 |
| Stoniness (class) | p | 0 | 0 | 0 | 2 |
| Depth to sand or gravel (cm) | q | NA | NA | NA | 0 |
| Rockiness (class) | r | 0 | 0 | 0 | 0 |
| Surface texture | s | C | SiCL | C | SL |
| Topographic slope class | t | b-c | b-c | b-c | c-f |
| Moist Consistence | u | Firm | Friable | Firm | Very Friable |
| Wetness or drainage class | w | I | W | W | W |
| Permafrost | z | NA | NA | NA | NA |

Table 11. Engineering Test Data for Several Soils in the Flin Flon Study

| Soil Name | Horizon | Depth cm | % Passing Sieve | | | | Total Sand | % of Sample | | Liquid Limit | Plastic Limit | Shrinkage Limit | Sat. % | Textural Classification | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 3 Sieve | .75 Sieve | No.4 Sieve | No.10 Sieve | | 50-2u Silt | 2u Clay | | | | | USDA | AASHO | Unified |
| Channing | Bm | 10-30 | | 88 | 70 | 59 | 95 | 4 | 1 | | | | 25.0 | | | |
| | IIC1 | 80-120 | | | | | 4 | 12 | 84 | | | | 77.0 | C | | |
| | IIC2 | 120-150 | | | | | 2 | 16 | 82 | 60.0 | 25.0 | 19.0 | 74.0 | C | A-7-6 | CH |
| Cliff | Bmgj | 5-40 | | | | | 86 | 8 | 6 | | | | 20.0 | LS | | |
| | IICkg | 55-100 | | | | 91 | 11 | 43 | 46 | 25.0 | 44.0 | 18.0 | 54.0 | C | A-7-6 | CL |
| Fay Lake | Bm | 4-30 | | 98 | 76 | 67 | 81 | 17 | 2 | | | | 23.3 | LS | | |
| | C | 50-100 | | 94 | 85 | 79 | 76 | 20 | 4 | | | | 16.7 | LS | | |
| Medard | Cg | 0-50 | | | | | 22 | 32 | 46 | | | | 58.0 | C | | |
| | Cg2 | 50-100 | | | | | 18 | 33 | 49 | 48.0 | 28.0 | 21.9 | 61.4 | C | A-7-6 | ML |
| Partridge Crop | Bm | 4-30 | | 80 | 70 | 67 | 94 | 4 | 2 | | | | 28.7 | CS | | |
| | C2 | 70-100 | | | | 99 | 96 | 2 | 2 | | | | 32.3 | S | | |
| Partridge Crop | Bm | 20-50 | | | | | 89 | 4 | 7 | | | | 26.2 | S | | |
| | C | 50-70 | | 99 | 95 | 93 | 65 | 23 | 12 | 17.0 | 15.0 | 14.8 | 23.8 | SL | A-4 | ML |
| Reed Lake Complex | 2Cg | 60-80 | | | | | 26 | 28 | 46 | | | | 66.9 | C | | |
| | 3Cg | 80-100 | | | | | 96 | 1 | 3 | | | | 28.3 | CS | | |
| Sipiwesk | Bt | 40-80 | | | | | 11 | 33 | 56 | 47.0 | 23.0 | 16.8 | 59.7 | C | A-7-6 | CL |
| | Ck2 | 120-160 | | | | | 7 | 47 | 46 | 44.0 | 21.0 | 21.7 | 67.3 | SiC | A-7-6 | CL |
| Wabowden | Bt | 20-60 | | | | | 8 | 20 | 72 | | | | 47.0 | C | | |
| | C | 75-100 | | | | | 5 | 39 | 56 | 43.0 | 22.0 | 17.0 | 53.0 | C | A-7-6 | CL |
| Wolverton | Bm | 10-25 | | 88 | 82 | 81 | 77 | 19 | 4 | | | | 29.0 | LS | | |
| | C | 40-90 | | 97 | 87 | 82 | 83 | 16 | 1 | | | | 28.0 | LS | | |
| Wolverton | Bm | 0-20 | | 94 | 83 | 78 | 68 | 22 | 10 | | | | 46.8 | SL | | |
| | C | 20-50 | | 96 | 77 | 72 | 74 | 18 | 8 | | | | 33.0 | SL | | |

## Guides for Assessing Soil Suitability

Guides for assessing soil suitability for ten engineering related uses are given in Appendix F (Tables 26 through 35). These tables provide as specifically as possible, definitions of the soil properties which result in the specific suitability or degree of limitation. In assessing soil suitability for various engineering uses, the degree of suitability is determined by the most restrictive or severe rating assigned to any one of the listed soil properties. For example, if the suitability is "Good" for all but one soil property and it is estimated to be "Very poor", then the overall rating of the soil for that selected use is "Very poor". Suitability of individual soil properties, if estimated to be "Fair" or "Poor", can be accumulative in their effect for a particular use. Judgement is required to determine whether the severity of the combined effects of several soil properties on suitability for a particular use will result in downgrading an evaluation. This is left to the discretion of the interpreter. It is incorrect to assume that each of the major soil properties influencing a particular use has an equal effect. Class limits established for rating the suitability of individual soil properties take this into account. For a selected use, therefore, only those soil properties which most severely limit that use are specified.

Engineering test data for several key soils in the study area are provided in Table 11.

Engineering description of the soils and their estimated properties significant to engineering are provided in Table 12. These data, in addition to information contained in the previous tables and other sections of the report have been used to rate the soils according to their suitability for ten selected engineering uses in Table 13. When using these interpretations consideration must be given to the following assumptions:

1. Interpretations are based on predictions of soil behavior under defined conditions of use and management as specified in the preamble to each of Tables 15 through 24 (Appendix F). When conditions of use and management are not the same as those defined here, new guides should be established and appropriate revisions made in Table 13.

2. Soil ratings do not include site factors such as nearness to towns and highways, water supply, aesthetic values, etc.

3. Soil ratings are based on natural, undisturbed soil.

4. Soil suitability ratings are usually given for the entire soil, but for some uses, they may be based on the limitations of an individual soil horizon or other earthy layer, because of its overriding importance. Ratings rarely apply to soil depths greater than 1 to 2 meters, but in some kinds of soils, reasonable estimates can be given for soil material at greater depths. It should be noted here that the term "soil" has been used throughout the report in the pedologic sense and differs in concept from that commonly used by engineers.

5. Poor and very poor soil ratings do not imply that a site cannot be changed to remove, correct or modify the soil limitations. The use of soils rated as poor depends on the nature of the limitations, whether or not the soil limitation can be altered suc-

cessfullly and economically, and on the scarcity of good sites.

6. Interpretations of map units do not eliminate the need for on-site evaluation by qualified professionals. Due to the variable nature of soils, and the scale of mapping, small, unmappable inclusions of soils with different properties may be present in an area where a development is planned. The need for or importance of on-site studies depends on the use to be made of the soil and the kinds of soil and soil problems involved.

## 4.5 SOIL SUITABILITY FOR SELECTED RECREATION USES

This section provides interpretations of the soil suitability for recreational development. All kinds of soil can be used for recreational activities of some kind.

Soils and their properties determine to a large degree, the type and location of recreational facilities. Wet soils are not suitable for campsites, roads, play grounds or picnic areas. Soils that pond and dry out slowly after heavy rains present problems where intensive use is contemplated. It is difficult to maintain grass cover for playing fields and golf courses on droughty soils. The feasibility of many kinds of outdoor activities are determined by other basic soil properties such as depth to bedrock, stoniness, topography or land pattern, and the ability of the soil to support vegetation of different kinds as related to its natural fertility.

The suitability of the various soil series and phases for selected recreation uses is shown in Table 14 according to four classes, Good, Fair, Poor and Very poor defined previously in the section on Engineering Uses. Subclasses are employed to identify the kind of limitation or hazard for a particular use. An explanation of subclass symbols is provided in Table 10.

The guidelines for various recreation uses are presented in Appendix F, Tables 25 through 28.

Table 12. Engineering Description of the Soils and Their Estimated Properties Significant to Engineering

| Map Symbol | Soil Series Name | Depth (cm) | Textural Classification | | | % Passing Sieve | | | Permeability cm/hr. | Reaction (pH) | Sulfate Hazard | Dispersion | Shrink-Swell Potential | Depth to Seasonal Water Table (m) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | USDA | Unified | AASHO | No. 10 2.0 mm | No. 40 0.42 mm | No. 200 0.074 mm | | | | | | |
| AKX | Atik | 0-60 | Mesic | Pt | Pt | - | - | - | >50 | 4.1 | Low | Low | Low | <.5 |
| | | 60-100 | CH | CH | A-7-6 | 100 | 100 | 100 | <.5 | 5.9 | Low | High | High | |
| CLF | Cliff | 0-50 | LS | SP | A-4 | 100 | 100 | 100 | >5 | 6.6 | Low | Low | Low | <.5 |
| | | 50-100 | CL | CL | A-7-6 | 100 | 100 | 100 | <.5 | 7.5 | Low | High | High | |
| CNN | Channing | 0- | LS | SP | A-4 | 100 | 100 | 100 | >5 | 4.6 | Low | Low | Low | <.5 |
| | | -100 | CH | CH | A-7-6 | 100 | 100 | 100 | <.5 | 6.4 | Low | High | High | |
| FYK | Fay Lake | 0-20 | SL | SM | A-2 | 67 | 76 | 98 | <5 | 4.4 | Low | Mod. | Low | >2 |
| | | 20-100 | SL | SM | A-2 | 79 | 85 | 94 | <5 | 4.8 | Low | Mod. | Low | |
| HGX | Hargrave | 0-17! | Mesic | Pt | - | - | - | - | >50 | 5.2 | Low | Low | Low | <.5 |
| MDR | Medard | 0-20 | C | ML | A-7-6 | 100 | 100 | 100 | <.5 | 6.9 | Low | High | High | |
| | | 20-100 | C | ML | A-7-6 | 100 | 100 | 100 | <.05 | - | Low | High | High | <1 |
| PCP | Partridge Crop | 0-20 | S-Gr | SP-GP | A-1 | - | - | - | >15 | 6.2 | Low | Low | Low | >3 |
| | | 20-100 | Gr | GP | A-1 | 92 | 85 | 80 | >15 | 6.4 | Low | Low | Low | |
| REX | Reed Lake | 0-20 | Fibric Peat | Pt | - | - | - | - | >50 | 6.0-7.0 | Low | | | <.5 |
| | | 20-120 | Mesic Peat | Pt | - | - | - | - | >50 | 6.5-7.5 | Low | | | |
| | | 120+ | L-C | ML-CH | A-4 to A-7-6 | 100 | 100 | 70-90 | 0.3 | 7.5-8.0 | Low | Low | Mod. High | |
| RLX | Rock Island | 0-200 | Mesic Peat | Pt | - | - | - | - | >50 | 6.0-7.0 | Low | | | <.5 |
| | | 200+ | C | CH | A-7-6 | 100 | 100 | 95-100 | 1.05-0.10 | 7.0-8.0 | Low | Low | High | |
| ROK | Roe Lake | 0-20 | C | CH | A-7-6 | 100 | 100 | 100 | <.5 | 4.8 | Low | High | High | <1.5 |
| | | 20-100 | C | CH | A-7-6 | 100 | 100 | 100 | <.05 | 7.0 | Low | High | High | |
| SWK | Sipiwesk | 0-20 | SiC | CH | A-7-6 | 100 | 100 | 100 | <1.5 | 4.9 | Low | High | High | >1.5 |
| | | 20-100 | SiC | CH | A-7-6 | 100 | 100 | 100 | <.5 | 7.7 | Low | High | High | |
| WBW | Wabowden | 0-20 | C | CH | A-7-6 | 100 | 100 | 100 | <.5 | 5.3 | Low | High | High | >1.5 |
| | | 20-100 | C | CH | A-7-6 | 100 | 100 | 100 | <.05 | 6.5 | Low | High | High | |
| WVT | Wolverton | | FSL | SM-SW | A-2 | 79 | 85 | 94 | <5 | 4.3 | Low | Mod. | Low | |
| | | | | R | | - | - | - | - | | - | - | - | |

TABLE 13. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

| Map Symbol and Phase | Soil Name | Top Soil | Sand & Gravel | Road Fill | Permanent Bldgs. With Basements | Local Roads and Streets | Sanitary Trench | Landfill Area | Cover Material | Sewage Lagoons | Septic Fields |
|---|---|---|---|---|---|---|---|---|---|---|---|
| AKX | Atik Complex | Vws | Va | Va | Vaw | Vaw | Vws | Vwh | Vsw | Vah | Vhg |
| aR | Precambrian Bedrock | Vb | Va | Vr | Vr | Vr | Vd | V | Vd | Vd | Vd |
| CNN | Channing | Vcb | Fd | Fd | Pw | G | Pk | Pk | Vs | Vka | Gg |
| CLF | Cliff | Vcb | Fd | Fd | Pw | Fw | Pkh | Pkh | Vs | Vka | Gg |
| FYK | Fay Lake | Pb | Pa | G | G | G | G | G | G | Fa | Fk |
| HGX | Hargrave Complex | Vws | Va | Va | Vaw | Vaw | Vws | Vwh | Vsw | Vah | Vhg |
| MRD | Medard | Psw | Va | Pa | Vw | Pwf | Vw | Pw | Psw | G | Vh |
| PCP | Partridge Crop | Vcb | G | G | G | G | Pk | Vk | Vs | Va | Gg |
| REX | Reed Lake Complex | Vws | Va | Va | Vaw | Vaw | Vws | Vwh | Vsw | Vah | Vhg |
| RLX | Rock Island Complex | Vws | Va | Va | Vaw | Vaw | Vws | Vwh | Vsw | Vah | Vhg |
| ROK | Roe Lake | Ps | Va | Pa | Fw | Paf | Ps | Pw | Ps | Fh | Pk |
| SWK | Sipiwesk | Ps | Va | Pa | Pa | Paf | Ps | G | Ps | G | Pk |
| WBW | Wabowden | Psu | Va | Pa | Pa | Paf | Pk | G | Ps | G | Pk |
| WVT | Wolverton | Pb | Pad | Fd | Pda | Fd | Vd | G | Pd | Pd | Fkd |

TABLE 14. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

| Map Symbol and Phase | Soil Name | Play Ground | Picnic Area | Camp Area | Path And Trails | Permanent Bldgs. Without Basements |
|---|---|---|---|---|---|---|
| AKX | Atik Complex | Vsw | Vsw | Vsw | Vsw | Vaw |
| aR | Precambrian Bedrock | Vr | Vr | Vr | Vr | Vr |
| CNN | Channing | Psc | Fs | Fs | G | G |
| CLF | Cliff | Psc | Fws | Pws | G | G |
| FYK | Fay Lake | Fk | G | G | G | G |
| HGX | Hargrave Complex | Vsw | Vsw | Vsw | Vsw | Vaw |
| MRD | Medard | Vw | Vw | Vw | Pws | Vw |
| PCP | Partridge Crop | Psc | Fs | G | G | G |
| REX | Reed Lake Complex | Vsw | Vsw | Vsw | Vsw | Vaw |
| RLX | Rock Island Complex | Vsw | Vsw | Vsw | Vsw | Vaw |
| ROK | Roe Lake | Fw | Fs | Fw | Fws | Fw |
| SWK | Sipiwesk | Ps | Fs | Fs | Fc | Fa |
| WBW | Wabowden | Ps | Fs | Fs | Fc | Pwf |
| WVT | Wolverton | Fk | G | G | G | Fda |

## Appendix A

## GLOSSARY

AASHO classification (soil engineering) - The official classification of soil materials and soil aggregate mixtures for highway construction used by the American Association of State Highway Officials.

Acid soil - A soil having a pH less than 7. See pH and Reaction, soil.

Alkaline soil - A soil having a pH greater than 7. See Reaction, soil.

Alluvium - A general term for all deposits of rivers and streams.

Arable soil - Soil suitable for plowing and cultivation.

Association - A sequence of soils of about the same age, derived from similar parent material, and occuring under similar climatic conditions but showing different characteristics due to variations in relief and in drainage.

1/3 Atmosphere Moisture - The moisture percentage on dry weight basis of a soil sample that has been air dried, screened, saturated and subjected to a soil moisture tension of 345 cm of water through a permeable membrane for a period of 48 hours. It approximates the soil moisture retention capacity.

Available nutrient - That portion of any element or compound in the soil that can be readily absorbed and assimilated by growing plants.

Available soil moisture - The portion of water in a soil that can be readily absorbed by plant roots: generally considered to be that water held in the soil up to approximately 15 atmospheres pressure.

Bearing capacity - Capacity of soil (in moist to wet conditions) to support loads such as buildings, people, vehicles, and animals.

Bedrock - The solid rock that underlies soil and regolith or that is exposed at the surface.

Boulders - Stones which are larger than 60 cm in diameter.

Bulk density - The weight of oven dry soil (105 degrees C) divided by its volume at field moisture conditions, expressed in grams per cubic centimeter.

Buried soil - Soil covered by an alluvial, loessial, or other deposit, usually to a depth greater than the thickness of the solum.

Calcareous soil - Soil containing sufficient calcium carbonate (often with magnesium carbonate) to effervesce visibly when treated with hydrochloric acid.

Calcium Carbonate Equivalent - Refers to the percent of carbonates in

the soil expressed on the basis of calcium carbonate. Terms used to express the carbonate contents of soils are:

noncalcareous . . . . . .<1%
weakly calcareous . . . . 1-5%
moderately calcareous . .6-15%
strongly calcareous . . 16-25%
v. strongly calcareous. 26-40%
extremely calcareous. . . >40%

Capillary fringe - A zone of essentially saturated soil just above the water table. The size distribution of the pores determines the extent and degree of the capillary fringe.

Carbon-nitrogen ratio (C/N ratio) - The ratio of the weight of organic carbon to the weight of total nitrogen in a soil or in an organic material.

Cation Exchange Capacity (CEC) - A measure of the total amount of exchangeable cations that can be held by a soil. Expressed in milliequivalents per 100g of soil.

Clay - As a soil separate, the mineral soil particles less than 0.002 mm in diameter: usually consisting largely of clay minerals. As a soil textural class, soil materials that contain 40 or more percent clay, less than 45 percent sand and less than 40 percent silt.

Cobbles - Rock fragments 8 to 25 cm in diameter.

Color - Soil colors are compared with a Munsell color chart. The Munsell system specifies the relative degrees of the three simple variables of color: hue, value and chroma. For example: 10YR 6/4 means a hue of 10YR, a value of 6, and a chroma of 4.

Complex (soil) - A mapping unit used in detailed and reconnaissance soil surveys where two or more soil series that are so intimately intermixed in an area that it is impractical to separate them at the scale of mapping used.

Concretions - Hard grains, pellets or nodules from concentration of compounds in the soil that cement soil grains together.

Conductivity, electrical - A physical quantity that measures the readiness with which a medium (irrigation water and soil extracts) transmits electricity. It expresses the concentration of salt in terms of the conductance (reciprocal of the electric resistance in ohms) in millisiemens per cm.

Consistence (soil) - The mutual attraction of the particles in a soil mass, or their resistence to separation or deformation. It is described in terms such as loose, soft, friable, firm, hard, sticky, plastic or cemented.

Consumptive use factor (CU) - The ratio of consumptive use of water by a crop to potential evapotranspiration. and transpiration. An actively growing crop that completely covers the soil over a large area and that has an ample supply of readily available soil water has a consumptive use factor of 1.0.

Consumptive use of water - The sum of the depths of water transpired by the plants and evaporated from the soil surface and from intercepted precipitation. It may be less or greater than potential evapotranspiration.

Contour - An imaginary line connecting points of equal elevation on the surface of the soil.

Cover - This term generally has one of the following meanings:

1. Vegetation or other material providing protection

2. In forestry, low growing shrubs and herbaceous plants under trees (i.e., ground cover vs. tree cover)

3. Any vegetation producing a protective mat on or just above the soil surface.

Creep (soil) - Slow mass movement of soil and soil material down rather steep slopes primarily under the influence of gravity, but aided by saturation with water and by alternate freezing and thawing.

Decile portion - A one-tenth portion. As used in the soil map symbol A7-B3 means that the A soils cover seven tenths and the B soils cover three tenths of the map unit.

Delta - A fluvial or glaciofluvial fan shaped deposit at the mouth of a river that empties into a lake or sea.

Deflocculate - To separate or to break up soil aggregates into individual particles by chemical or physical means or both.

Degradation (of soils) - The changing of a soil to a more highly leached and more highly weathered condition, usually accompanied by morphological changes such as the development of an eluviated light colored (Ae) horizon.

Dispersion - Is rated high, moderate or low depending on how readily the soil structure breaks down or slakes because of excess moisture. A rating of high indicates that soil aggregates slake readily; a rating of low indicates that aggregates are resistant to dispersion and remain clumped together.

Drainage (soil) - (1) The rapidity and extent of the removal of water from the soil by runoff and flow through the soil to underground spaces. (2) As a condition of the soil, it refers to the frequency and duration of periods when the soil is free of saturation.

Drainage in soil reports is described on the basis of actual moisture content in excess of field capacity and length of the saturation period within the plant root zone. The terms are as follows:

Very rapidly drained - Water is removed from the soil very rapidly in relation to supply. Excess water flows downward very rapidly if underlying material is pervious. There may be very rapid subsurface flow during heavy rainfall provided there is a steep gradient. Soils have very low available water storage capacity (usually less than 2.5 cm) within the control section and are usually coarse in texture, or shallow, or both. Water source is precipitation.

Rapidly drained - Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep gradients during heavy rainfall. Soils have low available water storage capacity (2.5-4 cm) within the control section, and are usually coarse in texture, or shallow, or both. Water source is precipitation.

Well drained - Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying pervious material or laterally as subsurface flow. Soils have intermediate available water storage capacity (4-5 cm) within the control section, and are generally intermediate in texture and depth. Water source is precipitation. On slopes subsurface flow may occur for short durations but additions are equaled by losses. These soils are usually free of mottles within 100 cm of the surface but may be mottled below this depth. Soil horizons are usually bright colored.

Moderately well drained - Water is removed from the soil somewhat slowly in relation to supply. Excess water is removed somewhat slowly due to low perviousness, shallow water table, lack of gradient, or some combination of these. Soils have intermediate to high water storage capacity (5-6cm) within the control section and are usually medium to fine in texture. Soils are commonly mottled in the 50 to 100 cm depth. Colors are dull brown in the subsoil with stains and mottles.

Imperfectly drained - Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly downward if precipitation is major supply. If subsurface water or groundwater, or both, is the main source, flow rate may vary but the soil remains wet for a significant part of the growing season. Precipitation is the main source if available water storage capacity is high; contribution by subsurface flow or groundwater flow, or both, increases as available water storage capacity decreases. Soils have a wide range in available water supply, texture, and depth, and are gleyed phases of well drained subgroups. These soils generally have mottling below the surface layers and generally have duller colors with depth, generally brownish gray with mottles of yellow and gray.

Poorly drained - Water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen. Excess water is evident in the soil for a large part of the time. Subsurface flow or groundwater flow, or both, in addition to precipitation are main water sources; there may also be a perched water table, with precipitation exceeding evapotranspiration. Poorly drained soils have a wide range in available water storage capacity, texture, and depth, and are gleyed subgroups, Gleysols, and Organic soils.

Very poorly drained - Water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time the soil is not frozen. Excess water is present in the soil for the greater part of the time. Groundwater flow and subsurface flow are major water sources. Precipitation is less important except where there is a perched water table with precipitation exceeding evapotranspiration. These soils have a wide range in available water storage capacity, texture, and depth, and are either Gleysolic or Organic.

Dryland farming - The practice of crop production in low rainfall areas without irrigation.

Eluvial horizon - A horizon from which material has been removed in solution or in water suspension.

Eolian - Soil material accumulated through wind action.

Erosion - The wearing away of the land surface by detachment and transport of soil and rock material through the action of moving water, wind or other geological processes. The ratings of erosion are:

Erosion 1 slightly eroded - soil with a sufficient amount of the A horizon removed that ordinary tillage will bring up and mix the B horizon or other lower lying horizons with surface soil in the plow layer.

Erosion 2 moderately eroded - soil with all of the A horizon and a part of the B or other lower lying horizons removed. The plow layer consists mainly of the original horizons below the A or below the original plow layer.

Erosion 3 severely eroded - soils have practically all of the original surface soil removed. The plow layer consists mainly of C horizon material, especially on knolls and steep upper slope positions.

Evapotranspiration - The combined loss of water from a given area, and during a specific period of time, by evaporation from the soil surface and transpiration from plants.

Field Moisture Equivalent - The minimum moisture content at which a drop of water placed on a smoothed surface of the soil will not be absorbed immediately by the soil, but will spread out over the surface and give it a shiny appearance.

Flood plain - The land bordering a stream, built up of sediments from overflow of the stream and subject to inundation when the stream is at flood stage.

Fluvial deposits - All sediments past and present, deposited by flowing water, including glaciofluvial deposits.

Frost heave - The raising of the surface caused by ice in the subsoil.

Friable - Soil aggregates that are soft and easily crushed between thumb and forefinger.

Glaciofluvial deposits - Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. These deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers and kame terraces.

Gleyed soil - An imperfectly or poorly drained soil in which the material has been modified by reduction or alternating reduction and oxidation. These soils have lower chromas or more prominent mottling or both in some horizons than the associated well-drained soil.

Gleysolic - An order of soils developed under wet conditions and permanent or periodic reduction. These soils have low chromas or prominent mottling or both, in some horizons.

Gravel - Rock fragments 2 mm to 7.5 cm in diameter.

Ground Moraine - An unsorted mixture of rocks, boulders, sand, silt and clay deposited by glacial ice. The predominant material is till; most till is thought to have accumulated under the ice by lodgment, but some till has been let down from the upper surface of the ice by ablation. Resorting and modification may have taken place to some extent by wave-action of glacial melt waters. The topography is most commonly in the form of undulating plains with gently sloping hills and enclosed depressions.

Groundwater - Water beneath the soil surface, usually under conditions where the voids are completely filled with water (saturation).

Halophytic vegetation - vegetation that grows naturally in soils having a high content of various salts. It usually has fleshy leaves or thorns and resembles desert vegetation.

Horizon (soil) - A layer in the soil profile approximately parallel to the land surface with more or less well-defined characteristics that have been produced through the operation of soil forming processes.

Horizon boundary - The lower boundary of each horizon is described by indicating its distinctness and form. The distinctness depends on the abruptness of vertical change (thickness). The form refers to the variation of the boundary plane.

Distinctness -
abrupt - less than 2 cm
clear - 2 to 5 cm
gradual - 5 to 15 cm
diffuse - more than 15 cm

Form -
smooth - nearly plain
wavy - pockets are wider than deep
irregular - pockets are deeper than wide
broken - parts of the horizon are unconnected with other parts

Humic layer - A layer of highly decomposed organic soil material containing little fibre.

Hydraulic Conductivity - Refers to the effective flow velocity or discharge velocity in soil at unit hydraulic gradient. It is an approximation of the permeability of the soil and is expressed in cm per hour. The classes are described in general or specific terms as:

| | | | |
|---|---|---|---|
| High | >15 | Very rapid | >50 |
| | | Rapid | 15-50 |
| Medium | 0.5-15 | Mod. rapid | 5.0-15 |
| | | Moderate | 1.5-5.0 |
| | | Mod. slow | 0.5-1.5 |
| Low | <0.5 | Slow | 0.15-0.5 |
| | | Very slow | 0.015-0.15 |
| | | Extremely slow | <.015 |

Hydrologic cycle - The conditions through which water naturally passes from the time of precipitation until it is returned to the atmosphere by evaporation and is again ready to be precipitated.

Hydrophyte - Plants growing in water or dependent upon wet or saturated soil conditions for growth.

Illuvial horizon - A soil horizon in which material carried from an overlying layer has been precipitated from solution or deposited from suspension. The layer of accumulation.

Impeded drainage - A condition that hinders the movement of water by gravity through the soils.

Inclusion - Soil type found within a mapping unit that is not extensive enough to be mapped separately or as part of a complex.

Infiltration - The downward entry of water into the soil

Irrigation - The artificial application of water to the soil for the benefit of growing crops.

Irrigation requirement (IR) - Refers to the amount of water exclusive of effective precipitation that is required for crop production.

Lacustrine deposits - Material deposited by or settled out of lake waters and exposed by lowering of the water levels or elevation of the land. These sediments range in texture from sand to clay and are usually varved (layered annual deposits).

Landforms - See Description of Landforms

Landscape - All the natural features such as fields, hills, forest, water, etc., which distinguish one part of the earth's surface from another part.

Leaching - The removal from the soil of materials in solution.

Liquid limit (upper plastic limit) - The water content corresponding to an arbitrary limit between the liquid and plastic states of consistency of a soil. The water content at this boundary is defined as that at which a pat of soil cut by a groove of standard dimensions will flow together for a distance of 1.25 cm under the impact of 25 blows in a standard liquid limit apparatus.

Lineal shrinkage - This is the decrease in one dimension expressed as a percentage of the original dimension of the soil mass when the moisture content is reduced from a stipulated percentage (usually field moisture equivalent) to the shrinkage limit.

Mapping Unit - Any delineated area shown on a soil map that is identified by a symbol. A mapping unit may be a soil unit, a miscellaneous land type, or a soil complex.

Marsh - Periodically flooded or continually wet areas having the surface not deeply submerged. It is covered dominantly with sedges, cattails, rushes or other hydrophytic plants.

Mature soil - A soil having well-developed soil horizons produced by the natural processes of soil formation.

Mesophyte - Plants requiring intermediate moisture conditions and are not very resistant to drought.

Microrelief - Small-scale, local differences in relief including mounds, swales or hollows.

Milliequivalent (me) - One-thousandth of an equivalent. An equivalent is the weight in grams of an ion or compound that combines with or replaces one gram of hydrogen. The atomic or formula weight divided by valence.

Mottles - Irregularly marked spots or streaks, usually yellow or orange but sometimes blue. They are described in order of abundance (few, common, many), size (fine, medium, coarse) and contrast (faint, distinct, prominent). Mottles in soils indicate poor aeration and lack of good drainage.

Organic carbon - Carbon derived from plant and animal residues.

Organic matter - The fraction of the soil which consists of plant and animal residues at various stages of decomposition, cells and tissues of soil organisms and substances synthesized by the soil population. It is determined on soils that have been sieved through a 2.0 mm sieve. It is estimated by multiplying the organic carbon by a factor of 1.72.

Outwash - Sediments "washed out" beyond the glacier by flowing water and laid down in thin beds or strata. Particle size may range from boulders to silt.

Ovendry soil - Soil that has been dried at 105 degrees C until it has reached constant weight.

Parent material - The unaltered or essentially unaltered mineral or organic material from which the soil profile develops by pedogenic processes.

Particle size, soil - The grain size distribution of the whole soil including the coarse fraction. It differs from texture, which refers to the fine earth (less than 2mm) fraction only. In addition, textural classes are usually assigned to specific horizons whereas soil family particle-size classes indicate a composite particle size of a part of the control section that may include several horizons. See Textural Triangle at end of Glossary.

The particle-size classes for family groupings are as follows:

Fragmental Stones, cobbles and gravel, with too little fine earth to fill interstices larger than 1 mm.

Sandy-skeletal Particles coarser than 2 mm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the sandy particle-size class.

Loamy-skeletal Particles 2 mm-25 cm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the loamy particle-size class.

Clayey-skeletal Particles 2 mm-25 cm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the clayey particle-size class.

Sandy The texture of the fine earth includes sands and loamy sands, exclusive of loamy very fine sand and very fine sand textures; particles 2 mm- 25 cm occupy less than 35% by volume.

Loamy The texture of the fine earth includes loamy very fine sand, very fine sand, and finer textures with less than 35% clay; particles 2 mm-25 cm occupy less than 35% by volume.

Coarse-loamy. A loamy particle size that has 15% or more by weight of fine sand (0.25-0.1 mm)

or coarser particles, including fragments up to 7.5 cm, and has less than 18% clay in the fine earth fraction.

Fine-loamy. A loamy particle size that has 15% or more by weight of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has 18-35% clay in the fine earth fraction.

Coarse-silty. A loamy particle size that has less than 15% of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has less than 18% clay in the fine earth fraction.

Fine-silty. A loamy particle size that has less than 15% of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has 18-35% clay in the fine earth fraction.

Clayey. The fine earth contains 35% or more clay by weight and particles 2mm-25 cm occupy less than 35% by volume.

Fine-clayey. A clayey particle size that has 35-60% clay in the fine earth fraction.

Very-fine-clayey. A clayey particle size that has 60% or more clay in the fine earth fraction.

Ped - An individual soil aggregate such as granule, prism or block formed by natural processes (in contrast with a clod which is formed artificially).

Pedology - Those aspects of soil science involving constitution, distribution, genesis and classification of soils.

Percolation - The downward movement of water through soil; specifically, the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of 1.0 or less.

Permafrost -

1. Perennially frozen material underlying the solum.

2. A perennially frozen soil horizon.

Permafrost table - The upper boundary of permafrost, usually coincident with the lower limit of seasonal thaw (active layer).

Permeability - The ease with which water and air pass through the soil to all parts of the profile. See hydraulic conductivity.

pH - The intensity of acidity and alkalinity, expressed as the negative logarithm of the hydrogen ion concentration. A pH of 7 is neutral, lower values indicate acidity and higher values alkalinity (see Reaction, soil).

Phase, soil - A soil phase is used to characterize soil and landscape properties that are not used as criteria in soil taxonomy. The major phase differentiae are: slope, erosion, deposition, stoniness, texture, salinity, and calcareousness.

Plastic Limit - The water content corresponding to an arbitrary limit between the plastic and the semisolid states of consistency of a soil.

Plasticity Index - The numerical difference between the liquid and the plastic limit. The plasticity index gives the range of moisture contents within which a soil exhibits plastic properties.

Potential evapotranspiration (PE) - The maximum quantity of water capable of being lost as water vapor, in a given climate, by a continuous stretch of vegetation covering the whole ground and well supplied with water.

Profile, soil - A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil - The acidity or alkalinity of a soil. Soil reaction classes are characterized as follows:

| | |
|---|---|
| extremely acid | pH <4.5 |
| very strongly acid | 4.5 to 5.0 |
| strongly acid | 5.1 to 5.5 |
| medium acid | 5.6 to 6.0 |
| slightly acid | 6.1 to 6.5 |
| neutral | 6.6 to 7.3 |
| mildly alkaline | 7.4 to 7.8 |
| mod. alkaline | 7.9 to 8.4 |
| strongly alkaline | 8.5 to 9.0 |
| very strongly alkaline | >9.0 |

Regolith - The unconsolidated mantle of weathered rock and soil material on the earth's surface.

Relief - The elevation of inequalities of the land surface when considered collectively.

Runoff - The portion of the total precipitation on an area that flows away through stream channels. Surface runoff does not enter the soil. Groundwater runoff or seepage flow from groundwater enters the soil before reaching the stream.

Saline Soil - A nonalkali soil containing soluble salts in such quantities that they interfere with the growth of most crop plants. The conductivity of the saturation extract is greater than 4 millisiemens/cm (ms/cm), the exchangeable-sodium percentage is less than 15, and the pH is usually less than 8.5. Approximate limits of salinity classes are:

| | |
|---|---|
| non-saline | 0 to 4 ms/cm |
| weakly saline | 4 to 8 mS/cm |
| mod. saline | 8 to 15 ms/cm |
| strongly saline | >15 ms/cm |

Salinization - The process of accumulation of salts in the soil.

Salt-Affected Soil - Soil that has been adversely modified for the growth of most crop plants by the presence of certain types of exchangeable ions or of soluble salts. It includes soils having an excess of salts, or an excess of exchangeable sodium or both.

Sand - A soil particle between 0.05 and 2.0 mm in diameter. The textural class name for any soil containing 85 percent or more of sand and not more than 10 percent of clay.

Saturation Percentage - The moisture percentage of a saturated soil paste, expressed on an oven dry weight basis.

Seepage -

1. The escape of water downward through the soil.

2. The emergence of water from the soil along an extensive line of surface in contrast to a spring where water emerges from a local spot.

Series, soil - A category in the Canadian System of Soil Classification. It consists of soils that have soil horizons similar in their differentiating characteristics and arrangement in the profile, except for surface tex-

ture and are formed from a particular type of parent material.

Shrinkage limit - This is the moisture content at which an equilibrium condition of volume change is reached and further reduction in moisture content will not cause a decrease in the volume of the soil mass.

Shrinkage ratio - This is the ratio between the volume change and a corresponding change in moisture content. It equals the apparent specific gravity of the dried soil.

Silt - (a) Individual mineral particles of soil that range in diameter between 0.05 to .002 mm. (b) Soil of the textural class silt contains greater than 80 percent silt and less than 12 percent clay.

Slickenside - Smoothed surfaces along planes of weakness resulting from the movement of one mass of soil against another in soils dominated by swelling clays.

Sodium-Adsorption Ratio (S.A.R.) - A ratio for soil extracts and irrigation waters used to express the relative activity of sodium ions in exchange reactions with other cations in the soil SAR = $Na/((Ca+Mg)/2)^{1/2}$ where the cation concentrations are expressed as milliequivalents per litre.

Soil - The unconsolidated mineral material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. Soil has been subjected to and influenced by genetic and environmental factors of: parent material, climate (including moisture and temperature effects), macro- and micro-organisms, and topography, all acting over a period of time.

Solum - The upper horizons of a soil above the parent material and in which the processes of soil formation are active. It usually comprises the A and B horizons.

Stones - Rock fragments greater than 25 cm in diameter.

Stoniness - The percentage of land surface occupied by stones. The classes of stoniness are defined as follows:

Stones 0. Nonstony -- Land having less than 0.01% of surface occupied by stones.

Stones 1. Slightly stony -- Land having 0.01-0.1% of surface occupied by stones. Stones 15-30 cm in diameter, 10-30 m apart. The stones offer only slight to no hindrance to cultivation.

Stones 2. Moderately stony -- Land having 0.1-3% of surface occupied by stones. Stones 15-30 cm in diameter, 2-10 m apart. Stones cause some interference with cultivation.

Stones 3. Very stony -- Land having 3-15% of surface occupied by stones. Stones 15-30 cm in diameter, 1-2 m apart. There are sufficient stones to constitute a serious handicap to cultivation.

Stones 4. Exceedingly stony -- Land having 15-50% of surface occupied by stones. Stones 15-30 cm in diameter, 0.7-1.5 m apart. There are sufficient stones to prevent cultivation until considerable clearing has been done.

Stones 5. Excessively stony -- Land having more than 50% of surface occupied by stones. Stones 15-30 cm in diameter, less than 0.7 m apart. The land is too stony to permit cultivation.

Storage Capacity - Refers to the maximum amount of readily available water that can be stored within the rooting zone of a crop in a given soil. For practical irrigation purposes, 50 percent of the total soil water between field capacity and wilting point may be considered as readily available.

Stratified materials - Unconsolidated sand, silt and clay arranged in strata or layers. In stratified materials, a bed is a unit layer distinctly separable from other layers and is one or more cm thick but a lamina is a similar layer less than 1 cm thick.

Structure - The combination or arrangement of primary soil particles into aggregates of secondary soil particles, units or peds, which are separated from each other by surfaces of weakness. Structure is expressed in terms of grade, size class and shape type. Grade refers to the distinctness of aggregate development, and is described as structureless, weak, moderate or strong. Structureless refers to the absence of observable aggregation of definite orderly arrangement; the term amorphous is used if soil is massive or coherent, single-grained if noncoherent. The weak to strong aggregates vary in size and are described by class as fine, medium, coarse, and very coarse depending on the shape types. The shape types refers to the dominant configuration of the aggregates and the way they are accommodated. The general shape types are plate-like, block-like and prism-like. The terms are:

Platy - Having thin, plate-like aggregates with faces mostly horizontal

Prismatic - Having prism-like aggregates with tops and edges, appear plane, level and somewhat angular.

Columnar - Having prism-like aggregates with vertical edges near the top of columns, not sharp.

Granular - Having block-like aggregates that appear as spheroids or polyhedrons having plane or curved surfaces which have slight or no accommodation to the faces of the surrounding peds.

Blocky - Having block-like aggregates with sharp, angular corners

Subangular blocky - Having block-like aggregates with rounded and flattened faces and rounded corners.

By convention an aggregate is described in the order of grade, class and type, e.g. strong, medium, blocky. In the parent material of soils the material with structural shapes may be designated as pseudo-blocky, pseudo-platy, etc.

Soil Survey - The systematic examination, description, classification, and mapping of soil in an area.

Sulfate Hazard - Refers to the relative degree of attack on concrete by soil and water containing various amounts of sulfate ions. It is estimated from electrolyte measurements and salt analysis on selected profiles and soil samples, and by visual examination of free gypsum within the profile during the course of soil investigation.

Swamp - See Description of Landforms

Texture, soil - The relative proportions of the fine earth (less than 2 mm.) fraction of a soil. Textural classes are usually assigned to specific horizons whereas family particle size classes indicate a composite particle size of a portion of the control section that may include several horizons. See Texture Triangle at end of Glossary.

The size range of the constituent primary particles are as follows:

| | Diameter (mm) |
|---|---|
| Very coarse sand. . . . | 2.0-1.0 |
| Coarse sand . . . . . | 1.0-0.5 |
| Medium sand . . . . . | 0.5-0.25 |
| Fine sand . . . . . | 0.25-0.10 |
| Very fine sand. . . . | 0.10-0.05 |
| Silt. . . . . | 0.05-0.002 |
| Clay. . . . . | < 0.002 |
| Fine clay . . . . . | < 0.0002 |

Till, glacial - Unstratified glacial deposits consisting of clay, sand, gravel, and boulders intermingled in any proportion.

Tilth - The physical condition of soil as related to its ease of tillage, fitness as a seedbed, and its impedance to seedling emergency and root penetration.

Topography - Refers to the percent slope and the pattern or frequency of slopes in different directions. A set of 10 slope classes are used to denote the dominant but not necessarily most abundant slopes within a mapping unit.

| Slope Class | Slope Name | Percent slope | Approx. degrees |
|---|---|---|---|
| 1 | level | 0-0.5 | 0 |
| 2 | nearly level | .5-2.5 | .3-1.5 |
| 3 | very gentle | 2-5 | 1-3 |
| 4 | gentle | 6-9 | 3.5-5 |
| 5 | moderate | 10-15 | 6-8.5 |
| 6 | strong | 16-30 | 9-17 |
| 7 | very strong | 31-45 | 17-24 |
| 8 | extreme | 46-70 | 25-35 |
| 9 | steep | 71-100 | 35-45 |
| 10 | very steep | >100 | >45 |

Underground runoff - (or seepage)-Water flowing towards stream channels after infiltration into the ground.

Unified Soil Classification System (engineering) - A classification system based on the identification of soils according to their particle size, gradation, plasticity index and liquid limit.

Urban Land - Areas so altered or obstructed by urban works or structures that identification of soils is not feasible.

Variant, soil - A soil whose properties are believed to be sufficiently different from other known soils to justify a new series name, but comprising such a limited geographic area that creation of a new series is not justified.

Varve - A distinct band representing the annual deposit in sedimentary materials regardless of origin and usually consisting of two layers, one thick light colored layer of silt and fine sand laid down in the spring and summer, and the other a thin, dark colored layer of clay laid down in the fall and winter.

Water balance, soil - Is the daily amount of readily available water retained by the soil. The daily soil-water balance is decreased by the amount that the daily consumptive use exceeds the daily rainfall. When daily rainfall exceeds the consumptive use, the daily balance increases by the amount of the difference unless the soil-water balance is at storage capacity, in which case the excess is assumed to be lost by runoff or deep percolation.

Water table - (groundwater surface; free water surface; groundwater elevation) Elevation at which the pressure in the water is zero with respect to the atmospheric pressure.

Water-holding capacity - The ability of a soil to hold water against the force of gravity in a freely drained soil.

Weathering - The physical and chemical disintegration, alteration and decomposition of rocks and minerals at or near the earth's surface by atmospheric agents.

Xerophyte - Plants capable of surviving extended periods of soil drought.

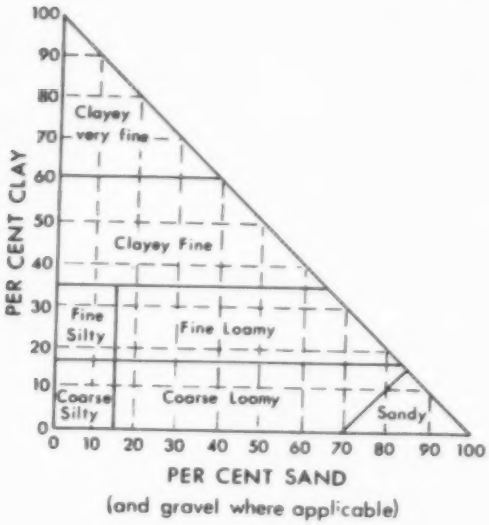
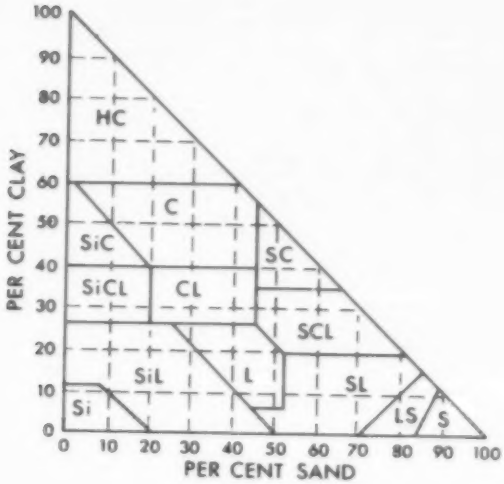



**Figure 15:** Family particle-size classes.




| Texture Group | Class Symbol | Class Name |
|---|---|---|
| Coarse | S | sand |
| | LS | loamy sand |
| Moderately coarse | SL | sandy loam |
| | LVFS | loamy very fine sand |
| Medium | Si | silt |
| | SiL | silt loam |
| | L | loam |
| | VFSL | very fine sandy loam |
| Moderately fine | SCL | sandy clay loam |
| | CL | clay loam |
| | SiCL | silty clay loam |
| Fine | SC | sandy clay |
| | C | clay |
| | SiC | silty clay |
| Very fine | HC | heavy clay |

**Figure 16:** Soil Textural Classes.

## Appendix B

## SOIL HORIZON DESIGNATIONS

### ORGANIC HORIZONS

Organic horizons are found in Organic soils, and commonly at the surface of mineral soils. They may occur at any depth beneath the surface in buried soils, or overlying geologic deposits. They contain more than 17% organic carbon (approximately 30% organic matter) by weight. Two groups of these horizons are recognized, O horizons and the L, F, and H horizons.

O This is an organic horizon developed mainly from mosses, rushes, and woody materials.

Of The fibric horizon is the least decomposed of all the organic soil materials. It has large amounts of well-preserved fiber that are readily identifiable as to botanical origin. A fibric horizon has 40% or more of rubbed fiber by volume and a pyrophosphate index of 5 or more. If the rubbed fiber volume is 75% or more, the pyrophosphate criterion does not apply.

Om The mesic horizon is the intermediate stage of decompostion with intermediate amounts of fiber, bulk density and water-holding capacity. The material is partly altered both physically and biochemically. A mesic horizon is one that fails to meet the requirements of fibric or humic.

Oh The humic horizon is the most highly decomposed of the organic soil materials. It has the least amount of fiber, the highest bulk density, and the lowest saturated water-holding capacity. It is very stable and changes very little physically or chemically with time unless it is drained. The humic horizon has less than 10% rubbed fiber by volume and a pyrophosphate index of 3 or less.

LFH These organic horizons developed primarily from leaves, twigs, woody materials and a minor component of mosses under imperfectly to well drained forest conditions.

L This is an organic horizon characterized by an accumulation of organic matter in which the original structures are easily discernible.

F This is an organic horizon characterized by an accumulation of partly decomposed organic matter. The original structures in part are difficult to recognize. The horizon may be partly comminuted by soil fauna as in moder, or it may be a partly decomposed mat permeated by fungal hyphae as in mor.

H This is an organic horizon characterized by an accumulation of decomposed organic

matter in which the original structures are indiscernible. This material differs from the F horizon by its greater humification chiefly through the action of organisms. It is frequently intermixed with mineral grains, especially near the junction with the mineral horizon.

**MASTER MINERAL HORIZONS**

Mineral horizons are those that contain less than 30% organic matter by weight as specified for organic horizons.

A This is a mineral horizon or horizons formed at or near the surface in the zone of leaching or removal of materials in solution and suspension or of maximum in situ accumulation of organic matter, or both. Included are:

1. horizons in which organic matter has accumulated as a result of biological activity (Ah);

2. horizons that have been eluviated of clay, iron, aluminum, or organic matter, or all of them (Ae);

3. horizons having characteristics of 1) and 2) above but transitional to underlying B or C (AB or A and B);

4. horizons markedly disturbed by cultivation or pasture (Ap).

B This is a mineral horizon or horizons characterized by one or more of the following:

1. an enrichment in silicate clay, iron, aluminum, or humus, alone or in combination (Bt,Bf,Bfh,Bhf, and Bh);

2. a prismatic or columnar structure that exhibits pronounced coatings or stainings and significant amount of exchangeable Na (Bn);

3. an alteration by hydrolysis, reduction, or oxidation to give a change in color or structure from horizons above or below, or both, and does not meet the requirements of 1) and 2) above (Bm,Bg).

C This is a mineral horizon or horizons comparatively unaffected by the pedogenic processes operative in A and B, excepting (i) the process of gleying, and (ii) the accumulation of calcium and magnesium carbonates and more soluble salts (Cca,Csa,Cg, and C). Marl and diatomaceous earth are considered to be C horizons.

R This is consolidated bedrock that is too hard to break with the hands or to dig with a spade when moist and that does not meet the requirement of a C horizon. The boundary between the R layer and overlying unconsolidated material is called a lithic contact.

W This is a layer of water in Gleysolic, Organic, or Cryosolic soils. It is called a hydric layer in Organic soils.

**LOWER-CASE SUFFIXES**

b Buried soil horizon.

c A cemented (irreversible) pedogenic horizon. The ortstein of a Podzol, and a layer cemented by calcium carbonate and a duripan are examples.

ca A horizon with secondary carbonate enrichment where the concentration of lime exceeds that present in the unenriched parent material. It is more than 10 cm thick, and if it has a $CaCO_3$ equivalent of less than 15 percent it should have at least 5 percent more $CaCO_3$ equivalent than the parent material (IC). If it has more than 15 percent $CaCO_3$ equivalent it should have 1/3 more $CaCO_3$ equivalent than the IC. If no IC is present, this horizon is more than 10 cm thick and contains more than 5 percent by volume of secondary carbonates in concretions or soft, powdery forms.

cc Cemented (irreversible) pedogenic concretions.

e A horizon characterized by the eluviation of clay, iron, aluminum, or organic matter alone or in combination. When dry, it is usually higher in color value by 1 or more units than an underlying B horizon. It is used with A (Ae).

f A horizon enriched with amorphous material, principally Al and Fe combined with organic matter. It usually has a hue of 7.5YR or redder or its hue is 10YR near the upper boundary and becomes yellower with depth. When moist, the chroma is higher than 3 or the value is 3 or less. It contains 0.6% or more pyrophosphate-extractable Al+Fe in textures finer than sand and 0.4% or more in sands (coarse sand, sand, fine sand, and very fine sand). The ratio of pyrophosphate-extractable Al+Fe to clay (less than 0.002mm) is more than 0.05 and organic C exceeds 0.5%. Pyrophosphate-extractable Fe is at least 0.3%, or the ratio of organic C to pyrophosphate-extractable Fe is less than 20, or both are true. It is used with B alone (Bf), with B and h (Bhf), with B and g (Bfg), and with other suffixes. The criteria for "f" do not apply to Bgf horizons. The following horizons are differentiated on the basis of organic carbon content: Bf - 0.5% to 5% organic carbon. Bhf-more than 5% organic carbon.

g A horizon characterized by gray colors, or prominent mottling, or both, indicative of permanent or periodic intense reduction. Chromas of the matrix are generally 1 or less. It is used with A and e (Aeg); with B alone (Bg); with B and f (Bfg); with B, h, and f (Bhfg); with B and t (Btg); with C alone (Cg); with C and k (Ckg); and several others. In some reddish parent materials, matrix colors of reddish hues and high chromas may persist despite long periods of reduction. In these soils, horizons are designated as g if there is gray mottling or if there is marked bleaching on ped faces or along cracks.

Aeg This horizon must meet the definitions of A,e, and g.

Bg These horizons are analogous to Bm horizons but they have colors indicative of poor drainage and periodic reduction. They include horizons occurring between A and C horizons in which the main features are (i) colors of low chroma, that is: chromas of 1 or less, without mottles on ped surfaces or in the matrix if peds are lacking; or chromas of 2 or less in hues of 10YR or redder, on ped surfaces or in the matrix if peds are lacking, accompanied by more promi-

nent mottles than those in the C horizon; or hues bluer than 10Y, with or without mottles on ped surfaces or in the matrix if peds are lacking. (ii) colors indicated in (i) and a change in structure from that of the C horizons. (iii) color indicated in (i) and illuviation of clay too slight to meet the requirements of Bt; or accumulation or iron oxide too slight to meet the limits of Bgf. (iv) colors indicated in (i) and removal of carbonates. Bg horizons occur in some Orthic Humic Gleysols and some Orthic Gleysols.

Bfg, Bhfg, Btg, and others. When used in any of these combinations the limits set for f, hf, t, and others must be met.

Bgf The dithionite-extractable Fe of this horizon exceeds that of the IC by 1% or more. Pyrophosphate-extractable Al + Fe is less than the minimum limit specified for 'f' horizons. This horizon occurs in Fera Gleysols and Fera Humic Gleysols, and possibly below the Bfg of gleyed Podzols. It is distinguished from the Bfg of gleyed Podzols on the basis of the extractability of the Fe and Al. The Fe in the Bgf horizon is thought to have accumulated as a result of the oxidation of ferrous iron. The iron oxide formed is not associated intimately with organic matter or with Al, and it is sometimes crystalline. The Bgf horizons are usually prominently mottled, with more than half of the soil material occurring as mottles of high chroma.

Cg, Ckg, Ccag, Csg, Csag. When g is used with C alone, or with C and one of the lower-case suffixes k, ca, s, or sa, it must meet the difinition for C and for the particular suffix.

h A horizon enriched with organic matter. It is used with A alone (Ah); or with A and e (Ahe); or with B alone (Bh); or with B and f (Bhf).

Ah A horizon enriched with organic matter that either has a color value at least one unit lower than the underlying horizon or contains 0.5% more organic carbon than the IC, or both. It contains less than 17% organic carbon by weight.

Ahe An Ah horizon that has undergone eluviation as evidenced, under natural conditions, by streaks and splotches of differing shades of gray and often by platy structure. It may be overlain by a darker-colored Ah and underlain by a lighter-colored Ae.

Bh This horizon contains more than 1% organic carbon, less than 0.3% pyrophosphate-extractable Fe, and has a ratio of organic carbon to pyrophosphate-extractable Fe of 20 or more. Generally the color value and chroma are less than 3 when moist.

Bhf Defined under 'f'.

j Used as a modifier of the suffixes e, f, g, n, and t to denote an expression of, but failure to meet, the specified limits of the suffix it modifies. It must be placed to the right and adjacent to the suffix it modifies. For example Bfgj means a Bf horizon with weak expression of gleying; Bfjgj means a B horizon with weak expression of both 'f' and 'g' features.

Aej It denotes an eluvial horizon that is thin, discontinuous or slightly discernible.

Btj It is a horizon with some illuviation of clay, but not enough to meet the limits of Bt.

Btgj, Bmgj. Horizons that are mottled but do not meet the criteria of Bg.

Bfj It is a horizon with some accumulation of pyrophosphate-extractable Al and Fe but not enough to meet the limits of Bf.

Bntj or Bnj. Horizons in which development of solonetzic B properties is evident but insufficient to meet the limits for Bn or Bnt.

k Denotes the presence of carbonate, as indicated by visible effervescence when dilute HCl is added. Most often it is used with B and m (Bmk) or C (Ck), and occasionally with Ah or Ap (Ahk, Apk), or organic horizons (Ofk, Omk).

m A horizon slightly altered by hydrolysis, oxidation, or solution, or all three, to give a change in color or structure, or both. It has:

1. Evidence of alteration in one of the following forms:

   a) Higher chromas and redder hues than the underlying horizons.

   b) Removal of carbonates, either partially (Bmk) or completely (Bm).

2. Illuviation, if evident, too slight to meet the requirements of a Bt or a podzolic B.

3. Some weatherable minerals.

4. No cementation or induration and lacks a brittle consistence when moist. This suffix can be used as Bm, Bmgj, Bmk, and Bms.

n A horizon in which the ratio of exchangeable Ca to exchangeable Na is 10 or less. It must also have the following distinctive morphological characteristics: prismatic or columnar structure, dark coatings on ped surfaces, and hard to very hard consistence when dry. It is used with B, as Bn or Bnt.

p A horizon disturbed by man's activities, such as cultivation, logging, habitation, etc. It is used with A and O.

s A horizon with salts, including gypsum, which may be detected as crystals or veins, as surface crusts of salt crystals, by depressed crop growth, or by the presence of salt-tolerant plants. It is commonly used with C and k (Csk), but can be used with any horizon or combination of horizon and lowercase suffix.

sa A horizon with secondary enrich-

ment of salts more soluble than calcium and magnesium carbonates, in which the concentration of salts exceeds that present in the unenriched parent material. The horizon is 10 cm or more thick. The conductivity of the saturation extract must be at least 4 ms/cm and must exceed that of the C horizon by at least one-third.

t An illuvial horizon enriched with silicate clay. It is used with B alone (Bt), with B and g (Btg), with B and n (Bnt), etc.

Bt A Bt horizon is one that contains illuvial layer-lattice clays. It forms below an eluvial horizon, but may occur at the surface of a soil that has been partially truncated. It usually has a higher ratio of fine clay to total clay than IC. It has the following properties:

1. If any part of an eluvial horizon remains and there is no lithologic discontinuity between it and the Bt horizon, the Bt horizon contains more total and fine clay than the eluvial horizons, as follows:

   a) If any part of the eluvial horizon has less than 15% total clay in the fine earth fraction (2mm) the Bt horizon must contain at least 3% more clay, e.g.,Ae 10% clay-Bt minimum 13% clay.

   b) If the eluvial horizon has more than 15% and less than 40% total clay in the fine earth fraction, the ratio of the clay in the Bt horizon to that in the eluvial horizon must be 1.2 or more, e.g., 20% clay increase in the Bt over Ae.

   c) If the eluvial horizon has more than 40% total clay in the fine earth fraction, the Bt horizon must contain at least 8% more clay than the eluvial horizon, e.g. Ae 50% clay; Bt at least 58% clay.

2. A Bt horizon must be at least 5 cm thick. In some sandy soils where clay accumulation occurs in the lamellae, the total thickness of the lamellae should be more than 10 cm in the upper 150 cm of the profile.

3. In massive soils the Bt horizon should have oriented clays in some pores and also as bridges between the sand grains.

4. If peds are present, a Bt horizon shows clay skins on some of the vertical and horizontal ped surfaces and in the fine pores, or shows oriented clays in 1% or more of the cross section, as viewed in thin section.

5. If a soil shows a lithologic discontinuity between the eluvial

horizon and the Bt horizon, or if only a plow layer overlies the Bt horizon, the Bt horizon need show only clay skins in some part, either in some fine pores or on some vertical and horizontal ped surfaces. Thin sections should show that some part of the horizon has about 1% or more of oriented clay bodies.

Btj, Btj, and Btg are defined under j and g.

u A horizon that is markedly disrupted by physical or faunal processes other than cryoturbation. Evidence of marked disruption such as the inclusion of material from other horizons, absence of the horizon, etc. must be evident in at least half of the cross section of the pedon. Such turbation can result from blowdown of trees, mass movement of soil on slopes, and burrowing animals. It can be used with any horizon or subhorizon with the exception of A or B alone; e.g. Aeu, Bfu, BCu.

x A horizon of fragipan character. A fragipan is a loamy subsurface horizon of high bulk density and very low organic matter content. When dry, it has a hard consistence and seems to be cemented. When moist, it has moderate to weak brittleness. It frequently has bleached fracture planes and is overlain by a friable B horizon. Air dry clods of fragic horizons slake in water.

y A horizon affected by cryoturbation as manifested by disrupted and broken horizons,, incorporation of materials from other horizons and mechanical sorting in at least half of the cross section of the pedon. It is used with A, B, and C alone or in combination with other subscripts, e.g. Ahy, Ahgy, Bmy, Cy, Cgy, Cygj, etc.

z A frozen layer. It may be used with any horizon or layer, e.g. Ohz, Bmz, Cz, Wz.

## Appendix C

## DESCRIPTION OF LANDFORMS

### C.1 GENETIC MATERIALS

**Unconsolidated mineral component**

The unconsolidated mineral component consists of clastic sediments that may or may not be stratified, but whose particles are not cemented together. They are essentially of glacial or post-glacial origin but include poorly consolidated and weathered bedrock.

Anthropogenic - Man-made or man-modified materials, including those associated with mineral exploitation and waste disposal.

Colluvial - Massive to moderately well stratified, nonsorted to poorly sorted sediments with any range of particle sizes from clay to boulders and blocks that have reached their present position by direct, gravity-induced movement.

They are restricted to products of mass-wasting whereby the debris is not carried by wind, water, or ice (excepting snow avalanches).

Eolian - Sediment, generally consisting of medium to fine sand and coarse silt particle sizes, that is well sorted, poorly compacted, and may show internal structures such as cross bedding or ripple laminae, or may be massive. Individual grains may be rounded and show signs of frosting.

These materials have been transported and deposited by wind action.

Fluvial - Sediment generally consisting of gravel and sand with a minor fraction of silt and clay. The gravels are typically rounded and contain interstitial sand. Fluvial sediments are commonly moderately to well sorted and display stratification, but massive, nonsorted fluvial gravels do occur. These materials have been transported and deposited by streams and rivers. Finer textured Fluvial deposits of modern rivers are termed Alluvium.

Lacustrine - Sediment generally consisting of either stratified fine sand, silt, and clay deposited on the lake bed; or moderately well sorted and stratified sand and coarser materials that are beach and other nearshore sediments transported and deposited by wave action.

These are materials that either have settled from suspension in bodies of standing fresh water or have accumulated at their margins through wave action.

Marine - Unconsolidated deposits of clay, silt, sand, or gravel that are well to moderately well sorted and well stratified to moderately stratified (in some places containing shells). They have settled from suspension in salt or brackish water bodies or have

accumulated at their margins through shoreline processes such as wave action and longshore drift.

Morainal - Sediment generally consisting of well compacted material that is nonstratified and contains a heterogeneous mixture of particle sizes, often in a mixture of sand, silt, and clay that has been transported beneath, beside, on, within and in front of a glacier and not modified by any intermediate agent.

Saprolite - Rock containing a high proportion of residual silts and clays formed by alteration, chiefly by chemical weathering.

The rock remains in a coherent state, interstitial grain relationships are undisturbed and no downhill movement due to gravity has occurred.

Undifferentiated - A layered sequence of more than three types of genetic material outcropping on a steep erosional escarpment.

Volcanic - Unconsolidated pyroclastic sediments. These include volcanic dust, ash, cinders, and pumice.

## Qualifying Descriptors

These have been introduced to qualify the genetic materials and to supply additional information about the mode of formation or depositional environment.

Glacial - Used to qualify nonglacial genetic materials or process modifiers where there is direct evidence that glacier ice exerted a strong but secondary or indirect control upon the mode of origin of the materials or mode of operation of the process. The use of this qualifying descriptor implies that glacier ice was close to the site of the deposition of a material or the site of operation of a process.

Glaciofluvial - Fluvial materials showing clear evidence of having been deposited either directly in front of or in contact with glacier ice.

Glaciolacustrine - Lacustrine materials deposited in contact with glacial ice.

Glaciomarine - Materials of glacial origin laid down in a marine environment, as a result of settling from melting, floating ice and ice shelves.

## Organic component

The organic component consists of peat deposits containing >30% organic matter by weight that may be as thin as 10 cm if they overlie bedrock but are otherwise greater than 40 cm and generally greater than 60 cm thick. The classes and their definitions follow.

| | |
|---|---|
| B | Bog |
| N | Fen |
| S | Swamp |

Bog - A bog is a peat-covered or peat-filled area, generally with a high water table. Since the surface of the peatland is slightly elevated, bogs are either unaffected or partly affected by nutrient-rich groundwaters from the surrounding mineral soils. The groundwater is generally acidic and low in nutrients (ombrotrophic). The dominant peat materials are sphagnum and forest peat, underlain, at times, by fen peat.

Fen - A fen is a peat-covered or peat-filled area with a high water table, which is usually at the surface. The dominant materials are shallow to deep, well to moderately decomposed fen peat. The waters are mainly rich in nutrients (minerotrophic) and are derived from mineral soils. The peat materials are therefore higher in both nutrients and pH than the peats associated with bogs.

Swamp - A swamp is a peat-covered or peat-filled area. The peat surface is level or slightly concave in cross section. The water table is frequently at or above the peat surface. There is strong water movement from margins or other mineral sources. The microrelief is hummocky, with many pools present. The waters are neutral or slightly acid. The dominant peat materials are shallow to deep mesic to humic forest and fen peat.

## C.2 GENETIC MATERIAL MODIFIERS

Material modifiers are used to qualify unconsolidated mineral and organic deposits. Particle-size classes serve to indicate the size, roundness, and sorting of unconsolidated mineral deposits. Fiber classes indicate the degree of decomposition and fiber size of organic materials.

### Particle size classes for unconsolidated mineral materials

Blocky: An accumulation of angular particles greater than 256 mm in size.

Bouldery: An accumulation of rounded particles greater than 256 mm in size.

Clayey: An accumulation of particles where the fine earth fraction contains 35% or more clay (<0.002 mm) by weight and particles greater than 2 mm are less than 35% by volume.

Cobbly: An accumulation of rounded particles having a diameter of 64-256 mm.

Gravelly: An accumulation of rounded particles ranging in size from pebbles to boulders.

Loamy: An accumulation of particles of which fine earth fraction contains 35% or less clay (<0.002 mm) by weight and particles greater than 2 mm are less than 35% by volume.

Pebbly: An accumulation of rounded particles having a diameter of 2-64 mm.

Rubbly: An accumulation of angular fragments having a diameter of 2-256 mm.

Sandy: An accumulation of particles of which the fine earth fraction contains more than 70% by weight of fine sand or coarser particles. Particles greater than 2 mm occupy less than 35% by volume.

Silty: An accumulation of particles of which the fine earth fraction contains less than 15% of fine sand or coarser particles and has less than 35% clay. Particles greater than 2 mm occupy less than 35% by volume.

**Fiber classes for organic materials**

The amount of fiber and its durability are important characterizing features of organic deposits in that they reflect on the degree of decomposition of the material. The prevalence of woody materials in peats is also of prime importance.

Fibric: The least decomposed of all organic materials; there is a large amount of well-preserved fiber that is readily identifiable as to botanical origin. Fibers retain their character upon rubbing.

Mesic: Organic material in an intermediate stage of decompostion; intermediate amounts of fiber are present that can be identified as to their botanical origin.

Humic: Highly decomposed organic material; small amounts of fiber are present that can be identified as to their botanical origin. Fibers can be easily destroyed by rubbing.

Woody: Organic material containing more than 50% of woody fibers.

## C.3 SURFACE EXPRESSION

The surface expression of genetic materials is their form (assemblage of slopes) and pattern of forms. Form as applied to unconsolidated deposits refers specifically to the product of the initial mode of origin of the materials. When applied to consolidated materials, form refers to the product of their modification by geological processes. Surface expression also indicates the manner in which unconsolidated genetic materials relate to the underlying unit.

**Consolidated and Unconsolidated mineral surface classes**

Apron - A relatively gentle slope at the foot of a steeper slope and formed by materials from the steeper, upper slope.

Blanket - A mantle of unconsolidated materials thick enough to mask minor irregularities in the underlying unit but still conforming to the general underlying topography.

Fan - A fan-shaped form similar to the segment of a cone and having a perceptible gradient from the apex to the toe.

Hummocky - A very complex sequence of slopes extending from somewhat rounded depressions or kettles of various sizes to irregular to conical knolls or knobs. There is a general lack of concordance between knolls or depressions. Slopes are generally 9-70% (5-35 degrees).

Inclined - A sloping, unidirectional surface with a generally constant slope not broken by marked irregularities. Slopes are 2-70% (1-35 degrees). The form of inclined slopes is not related to the initial mode of origin of the underlying material.

Level - A flat or very gently sloping, unidirectional surface with a generally constant slope not broken by marked elevations and depressions. Slopes are generally less than 2% (1 degree).

Rolling - A very regular sequence of moderate slopes extending from rounded, sometimes confined concave depressions to broad, rounded convexities producing a wave-lake pattern of moderate relief. Slope length is often 1.6 km or

greater and gradients are greater than 5% (3 degrees).

Ridged - A long, narrow elevation of the surface, usually sharp crested with steep sides. The ridges may be parallel, subparallel, or intersecting.

Steep - Erosional slopes, greater than 70% (35 degrees), on both consolidated and unconsolidated materials. The form of a steep erosional slope on unconsolidated materials is not related to the initial mode of origin of the underlying material.

Terraced - Scarp face and the horizontal or gently inclined surface (tread) above it.

Undulating - A very regular sequence of gentle slopes that extends from rounded, sometimes confined concavities to broad rounded convexities producing a wavelike pattern of low local relief. Slope length is generally less than 0.8 km and the dominant gradient of slopes is 2-5% (1-3 degrees).

Veneer - Unconsolidated materials too thin to mask the minor irregularities of the underlying unit surface. A veneer will range from 10 cm to 1 m in thickness and will possess no form typical of the material's genesis.

**Organic surface classes**

Blanket - A mantle of organic materials that is thick enough to mask minor irregularities in the underlying unit but still conforms to the general underlying topography.

Bowl - A bog or fen occupying concave-shaped depressions.

Domed - A bog with an elevated, convex, central area much higher than the margin. Domes may be abrupt (with or without a frozen core) or gently sloping or have a stepped surface.

Floating - A level organic surface associated with a pond or lake and not anchored to the lake bottom.

Horizontal - A flat peat surface not broken by marked elevations and depressions.

Plateau - A bog with an elevated, flat, central area only slightly higher than the margin.

Ribbed - A pattern of parallel or reticulate low ridges associated with fens.

Sloping - A peat surface with a generally constant slope not broken by marked irregularities.

Veneer - A thin (40 cm-1m) mantle of organic materials which generally conforms to the underlying topography. They may or may not be associated with discontinuous permafrost.

## Appendix D

## SUPPLEMENTAL INFORMATION

Morphological and Analytical Data For Selected Soils in the Flin Flon Study Area

| Soil Symbol | Soil Name | Year | Profile Number |
|---|---|---|---|
| ATX | Atik | 1981 | 55 |
| FYK | Fay Lake | 1981 | 60 |
| CLF | Cliff | 1980 | 72 |
| CNN | Channing | 1980 | 70 |
| HGX | Hargrave | 1980 | 71 |
| HGX | Hargrave | 1980 | 69 |
| MDR | Medard | 1981 | 59 |
| PCP | Partridge Crop | 1981 | 54 |
| PCP | Partridge Crop | 1981 | 56 |
| REX | Reed Lake | 1981 | 58 |
| RLX | Rock Island | 1981 | 53 |
| SWK | Sipiwesk | 1981 | 57 |
| WBW | Wabowden | 1980 | 68 |
| WVT | Wolverton | 1980 | 74 |
| WVT | Wolverton | 1981 | 61 |

*Profile descriptions have been computer generated from detailed sample sites and analytical information stored in the Canada Soil Information System (CanSIS) data bank.

Analytical Methodology:

Field samples were collected from representative sites. Samples were air-dried and ground, and the less than 2 mm size fraction was used for subsequent analysis.

| | |
|---|---|
| pH: | 0.01 M $CaCl_2$ |
| Organic Carbon: | Wet oxidation (Walkley-Black) |
| Total Nitrogen: | Macro-Kjeldahl; $NO_2$ and $NO_3$ not included |
| Equivalent: | Pressure method |
| Extractable Acidity: | $BaCl_2$ - Triethanolamine, pH 8.0 |
| Cation Exchange Capacity: | Buffered $NH_4Ac$; pH 7.0 solution, done by atomic absorption procedure |
| Electrical Conductivity: | saturated paste, using conductivity cell-cup |
| Particle Size Analysis: | Pipette method. Pretreatment removal of organic matter and salts. Dispersion with sodium hexameta-phosphate |
| Water Content: | Pressure membrane method. Samples are ground, sieved, and oven-dried |
| Atterberg Limits: | A.S.T.M. Designation D423-54T, "Procedures for Testing Soils", pages 94-101 |
| Shrinkage Limit: | Evaporation method |

Codes for Engineering Classification

AASHO

| | | | |
|---|---|---|---|
| A-1 | = 10 | A-3 | = 30 |
| A-1-a | = 11 | A-4 | = 40 |
| A-1-b | = 12 | A-5 | = 50 |
| A-2 | = 20 | A-6 | = 60 |
| A-2-4 | = 24 | A-7 | = 70 |
| A-2-5 | = 25 | A-7-5 | = 75 |
| A-2-6 | = 26 | A-7-6 | = 76 |
| A-2-7 | = 27 | A-8 | = 80 |

Unified

| | | | |
|---|---|---|---|
| GW | = 01 | DL | = 11 |
| GP | = 02 | MH | = 12 |
| GM | = 03 | CH | = 13 |
| GC | = 04 | OH | = 14 |
| SW | = 05 | PT | = 15 |
| SP | = 06 | Cl | = 16 |
| SM | = 07 | GM-GC | = 17 |
| SC | = 08 | SM-SC | = 18 |
| ML | = 09 | CL-ML | = 19 |
| CL | = 10 | | |

FEB 06, 1987

ATX MANITOBA 1981 PROFILE NO. 55

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF DETAILED SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: TERRIC MESISOL. SOIL MAP UNIT: COMPLEX, NOTATION: AKX.

LOCATION: MILITARY GRID REF. 14 ULR 1538 7737; NTS MAP AREA 63K 13; SW 19 67 29 W.

CLIMATE: 1100 FEET ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON

VEGETATION: BLACK SPRUCE,LEDUM, CHAMAE DAPHNE CHALYCULATA, BOG COTTON.

SOIL SITE: PARENT MATERIAL 1: ORGANIC, A429; PARENT MATERIAL 2: CLAYEY (>35% CLAY), WEAKLY CALCAREOUS (1 TO 6% CACO3), LACUSTRINE; SLOPE: SLIGHTLY MOUNDED MICROTOPOGRAPHY,; SOIL MOISTURE AND DRAINAGE: SUBAQUIC, IMPERFECTLY DRAINED, 0.4 M TO WATERTABLE; PRESENT LAND USE: BOG.

SPECIAL NOTES: PEAT IS VERY STRATIFIED AND HAS UNDERGONE A SERIES OF BURNSS INDICATED BY THE NUMEROUS ASHY LAYERS. SURFACE IS SLIGHTLY HUMMOCKY. SPHAGNUM IS NOT ACTIVELY GROWING-ATIK SERIES

OF: 0 TO 25 CM, RANGE 10 TO 30 CM; MATERIAL COMPOSITION NO DECOMPOSITION; <10% BY VOLUME; ORGANIC.

OM: 25 TO 60 CM, RANGE 20 TO 40 CM; MATERIAL COMPOSITION SLIGHT DECOMPOSITION; 10-20% BY VOLUME; ORGANIC.

OM2: 60 TO 90 CM, RANGE 20 TO 50 CM; MATERIAL COMPOSITION SLIGHT DECOMPOSITION; <10% BY VOLUME; ORGANIC.

OH: 90 TO 110 CM, RANGE 10 TO 25 CM; MATERIAL COMPOSITION HIGH DECOMPOSITION; <10% BY VOLUME; ORGANIC.

OH2: 110 TO 120 CM, RANGE 10 TO 15 CM; MATERIAL COMPOSITION HIGH DECOMPOSITION; <10% BY VOLUME; ORGANIC.

CG: 120 TO 135 CM; CLAY; MASSIVE STRUCTURE; STICKY, VERY PLASTIC CONSISTENCE; .

CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | PYRO EXTR C-% | TOTAL N (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OF | 3.4 | 58.38 | 7.5 | 0.77 | 99.9 | 126.4 | | 17.5 | 4.1 | 0.3 | 0.9 |
| OM | 3.3 | 59.38 | 22.5 | 0.88 | 99.9 | 141.1 | | 19.2 | 7.3 | 0.2 | 0.1 |
| OM2 | 4.1 | 62.70 | 99.9 | 0.98 | 82.7 | 167.0 | | 43.3 | 10.8 | 0.1 | |
| OH | 4.8 | 57.71 | 99.9 | 1.32 | 78.8 | 176.7 | | 76.6 | 19.8 | 0.2 | |
| OH2 | 5.1 | 55.22 | 84.0 | 2.49 | 61.1 | 155.9 | | 75.0 | 18.5 | 0.2 | |
| CG | 5.9 | | | | 5.5 | 31.3 | | 13.4 | 10.6 | 0.1 | 0.3 |

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CHEMICAL DATA (SURVEY)

| HORIZON | % H2O AT SATUR |
|---|---|
| OF | |
| OM | |
| OM2 | |
| OH | |
| OH2 | |
| CG | 466.6 |

PHYSICAL DATA (SURVEY)

| | | | | PARTICLE SIZE ANALYSIS | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | % PASSING | | | | | | | | | | % OF SAMPLE | | | |
| HORIZON | RUB FIB % | UNRUB FIBRE % | % ASH | 3 SIEVE | .75 SIEVE | NO.4 SIEVE | NO.10 SIEVE | V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
| OF | 94 | 99 | 3 | | | | | | | | | | | | | | |
| OM | 72 | 80 | 4 | | | | | | | | | | | | | | |
| OM2 | 26 | 50 | 6 | | | | | | | | | | | | | | |
| OH | 30 | 60 | 11 | | | | | | | | | | | | | | |
| OH2 | 22 | 48 | 14 | | | | | | | | | | | | | | |
| CG | | | | | | | | | | | | | 8 | | 32 | 60 | |

PHYSICAL DATA

| | ENGINEERING | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| HORIZON | ATTERBURG PLASTIC LIMIT (%) | ATTERBURG LIQUID LIMIT (%) | SHRINKAGE LIMIT (%) | OPT MOIST CONTENT (%) | MAX DRY DENSITY (G/CC) | COLE VALUE | AASHO CLASS | UNIFIED CLASS |
| OF | | | | | | | | |
| OM | | | | | | | | |
| OM2 | | | | | | | | |
| OH | | | | | | | | |
| OH2 | | | | | | | | |
| CG | 28.0 | 52.0 | 18.0 | | | | 76 | 13 |

FEB 06, 1987

CLF MANITOBA 1980 PROFILE NO. 72

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF DETAILED SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; LIMITED EXTENT; SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: GLEYED DYSTRIC BRUNISOL. MINERAL SOIL FAMILY: SANDY/CLAYEY, COLD, SUBAQUIC. SOIL MAP UNIT: TAXONOMIC SERIES, ASSOCIATED SOILS: CLK. SOIL PHASES: LEVEL AND PEATY.

LOCATION: MILITARY GRID REF. 14 ULR 1780 7436; NTS MAP AREA 63K 13W; NW 9 67 29 W.

CLIMATE: 1100 FEET ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON

VEGETATION: WHITE SPRUCE POPLAR,LEDUM AND ASSOCIATED SHRUBS.

SOIL SITE: PARENT MATERIAL 1: SANDY, MEDIUM ACID TO NEUTRAL (PH 5.6-7.3), FLUVIAL; PARENT MATERIAL 2: CLAYEY (>35% CLAY), WEAKLY CALCAREOUS (1 TO 6% CACO3), LACUSTRINE; SLOPE: 0.5% SLOPE OF CLASS 1 (0-0.5%); SOIL MOISTURE AND DRAINAGE: SUBAQUIC, IMPERFECTLY DRAINED, SLOW SURFACE RUNOFF, 0.4 M TO PERCHED WATERTABLE; PRESENT LAND USE: UNPRODUCTIVE WOODLAND.

SPECIAL NOTES: HAS PERCHED WATER TABLE OVER THE CLAY BLACK AH TONGUES INTO BMGJ. BMGJ HAS HIGH CHROMA POSSIBLY DUE TO PERIODIC DRY SPELLS. WATER SEEPED FREELY INTO PIT AT CLAY CONTACT.

LH: 15 TO 0 CM, RANGE 10 TO 20 CM; HORIZON WET; MATRIX MOIST 2.5Y 2/0; ORGANIC; STRUCTURELESS STRUCTURE; ABUNDANT, MEDIUM, VERTICAL, INPED ROOTS; SLIGHTLY POROUS; SMOOTH, ABRUPT HORIZON BOUNDARY.

AH: 0 TO 5 CM, RANGE 0 TO 10 CM; HORIZON WET; MATRIX MOIST 10YR 2/1; CLAY; STRUCTURELESS STRUCTURE; SLIGHTLY STICKY CONSISTENCE; ABUNDANT, MEDIUM, VERTICAL, INPED ROOTS; SLIGHTLY POROUS; BROKEN, CLEAR HORIZON BOUNDARY.

BMGJ: 5 TO 40 CM, RANGE 25 TO 40 CM; HORIZON WET; MATRIX MOIST 10YR 3/3; LOAMY SAND; STRUCTURELESS, MEDIUM TO COARSE, SINGLE GRAIN STRUCTURE; NONSTICKY CONSISTENCE; FEW, FINE, VERTICAL, INPED ROOTS; HIGHLY POROUS; WAVY, GRADUAL HORIZON BOUNDARY.

BC: 40 TO 55 CM, RANGE 5 TO 15 CM; HORIZON WET; 10YR 4/3; LOAMY SAND; STRUCTURELESS, MEDIUM TO COARSE, SINGLE GRAIN STRUCTURE; NONSTICKY CONSISTENCE; VERY FEW, VERY FINE, VERTICAL, INPED ROOTS; HIGHLY POROUS; WAVY, ABRUPT HORIZON BOUNDARY.

2CKG: 55 TO 100 CM; HORIZON WET; MATRIX MOIST 2.5Y 4/2; CLAY; STRUCTURELESS, MASSIVE STRUCTURE; VERY STICKY CONSISTENCE; SLIGHTLY POROUS; WEAK EFFERVESCENCE; WEAKLY CALCAREOUS.

CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | TOTAL N (%) | CALC CARB EQU.% | CAL-CITE (%) | DOLO-MITE (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH | 6.1 | 45.69 | 1.28 | | | | 44.2 | 175.2 | | 109.8 | 14.7 | 0.3 | 1.0 |
| AH | 6.6 | 6.48 | 0.33 | | | | 13.5 | 65.0 | | 44.4 | 7.9 | 0.1 | 0.2 |
| BMGJ | 6.8 | 0.17 | 0.02 | | | | 0.7 | 6.2 | | 5.4 | 0.8 | | 0.1 |
| BC | 7.0 | 0.13 | 0.02 | | | | 0.5 | 6.7 | | 5.9 | 1.0 | | 0.1 |
| 2CKG | 7.5 | | | 7.4 | 6.1 | 1.3 | | 20.1 | | 29.3 | 4.6 | 0.1 | 0.5 |

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CHEMICAL DATA (SURVEY)

| HORIZON | ELEC COND (MMHOS/CM) | % H2O AT SATUR |
|---|---|---|
| LH | 0.4 | 460.0 |
| AH | 0.4 | 72.0 |
| BMGJ | 0.2 | 20.0 |
| BC | 0.2 | 21.0 |
| 2CKG | 0.3 | 54.0 |

PHYSICAL DATA (SURVEY)

PARTICLE SIZE ANALYSIS

| HORIZON | % PASSING 3 SIEVE | .75 SIEVE | NO.4 SIEVE | NO.10 SIEVE | V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | % OF SAMPLE 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH | | | | | | | | | | | | | | |
| AH | | | | | 7 | 9 | 8 | 5 | 3 | 32 | | 18 | 50 | |
| BMGJ | | | | | 13 | 23 | 28 | 16 | 6 | 86 | | 8 | 6 | |
| BC | | | | 90 | 12 | 22 | 30 | 16 | 5 | 85 | | 8 | 7 | |
| 2CKG | | | | 91 | | 2 | 3 | 3 | 3 | 11 | | 43 | 46 | |

PHYSICAL DATA

ENGINEERING

| HORIZON | ATTERBURG PLASTIC LIMIT (%) | ATTERBURG LIQUID LIMIT (%) | SHRINKAGE LIMIT (%) | OPT MOIST CONTENT (%) | MAX DRY DENSITY (G/CC) | COLE VALUE | AASHO CLASS | UNIFIED CLASS |
|---|---|---|---|---|---|---|---|---|
| LH | | | | | | | | |
| AH | | | | | | | | |
| BMGJ | | | | | | | | |
| BC | | | | | | | | |
| 2CKG | 44.0 | 25.0 | 18.0 | | | | 76 | 10 |

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF DETAILED SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; VERY LIMITED EXTENT; SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: ELUVIATED DYSTRIC BRUNISOL. MINERAL SOIL FAMILY: SANDY/CLAYEY, NEUTRAL, COLD, HUMID. SOIL MAP UNIT: TAXONOMIC SERIES, NOTATION: CNN. SOIL PHASES: VERY STRONGLY SLOPING.

LOCATION: MILITARY GRID REF. 14 ULR 1880 6990; NW 29 66 29 W.

CLIMATE: 1000 FEET ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON

VEGETATION: FOREST,HARDWOOD, MATURE. ASPEN.

SOIL SITE: PARENT MATERIAL 1: SANDY, MEDIUM ACID TO NEUTRAL (PH 5.6-7.3), FLUVIAL; PARENT MATERIAL 2: CLAYEY (>35% CLAY), MEDIUM ACID TO NEUTRAL (PH 5.6-7.3), LACUSTRINE; LANDFORM CLASSIFICATION: FLUVIAL, HUMMOCKY; SLOPE: 25% COMPLEX SLOPE OF CLASS 6 (16-30%), FACING SOUTH, SITE AT MIDDLE POSITION, 50 M LONG; SOIL MOISTURE AND DRAINAGE: HUMID, VERY RAPIDLY DRAINED, RAPIDLY PERVIOUS, MODERATE SURFACE RUNOFF; SLIGHTLY STONY; PRESENT LAND USE: PRODUCTIVE WOODLAND.

SPECIAL NOTES: SAMPLE SITE IN AN EXPOSED FACE OF A BORROW PIT.SANDY GRAVEL OVERLYING CLAY IS COMMON EAST OF SCHIST LAKE. SOME AREAS HAVE BEEN USED AS GRAVEL SOURCE- CHANNING SERIES

LH: 10 TO 0 CM, RANGE 2 TO 15 CM; MATRIX DRY 10YR 2/2; ORGANIC; STRUCTURELESS STRUCTURE; ABUNDANT, FINE, VERTICAL, INPED ROOTS; HIGHLY POROUS, INTERSTITIAL PORES; SMOOTH, ABRUPT HORIZON BOUNDARY.

AE: 0 TO 10 CM, RANGE 5 TO 15 CM; MATRIX MOIST 10YR 5/3; SAND; STRUCTURELESS STRUCTURE; ABUNDANT, MEDIUM, VERTICAL, INPED ROOTS; HIGHLY POROUS, INTERSTITIAL PORES; WAVY, CLEAR HORIZON BOUNDARY; SLIGHTLY ACID 6.1-6.5 FIELD PH.

BM: 10 TO 30 CM, RANGE 15 TO 30 CM; MATRIX MOIST 10YR 4/4; SAND; STRUCTURELESS STRUCTURE; PLENTIFUL, MEDIUM, VERTICAL, INPED ROOTS; HIGHLY POROUS, INTERSTITIAL PORES; 20% GRAVELLY COARSE FRAGMENTS; WAVY, GRADUAL HORIZON BOUNDARY; NEUTRAL 6.6-7.3 FIELD PH.

BC: 30 TO 55 CM, RANGE 10 TO 30 CM; MATRIX MOIST 10YR 5/6; SAND; STRUCTURELESS STRUCTURE; FEW, VERY FINE, VERTICAL, INPED ROOTS; HIGHLY POROUS, INTERSTITIAL PORES; 30% GRAVELLY COARSE FRAGMENTS; SMOOTH, CLEAR HORIZON BOUNDARY; NEUTRAL 6.6-7.3 FIELD PH.

C: 55 TO 80 CM, RANGE 10 TO 25 CM; MATRIX MOIST 10YR 6/3; SAND; STRUCTURELESS STRUCTURE; VERY FEW, VERY FINE, VERTICAL, INPED ROOTS; HIGHLY POROUS, INTERSTITIAL PORES; 20% GRAVELLY COARSE FRAGMENTS; SMOOTH, ABRUPT HORIZON BOUNDARY; NEUTRAL 6.6-7.3 FIELD PH.

2C1: 80 TO 120 CM; MATRIX MOIST 10YR 4/3; CLAY; WEAK, VERY FINE TO FINE, SUBANGULAR BLOCKY STRUCTURE; FEW, FINE, HORIZONTAL, INPED ROOTS; SLIGHTLY POROUS, CRACKS AND FISSURE PORES; NEUTRAL 6.6-7.3 FIELD PH.

2C2: 120 TO 150 CM; MATRIX MOIST 10YR 4/3; CLAY; VERY FINE TO FINE, SUBANGULAR BLOCKY STRUCTURE; VERY FEW, VERY FINE, HORIZONTAL, INPED ROOTS; SLIGHTLY POROUS, CRACKS AND FISSURE PORES; NEUTRAL 6.6-7.3 FIELD PH.

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CNN MANITOBA 1980 PROFILE NO. 70

CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | TOTAL N (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|
| LH | 5.6 | 31.47 | 1.02 | 23.1 | 67.7 | | 34.1 | 5.0 | 0.1 | 1.5 |
| AE | 4.6 | 0.68 | 0.03 | 2.8 | 5.4 | | 2.2 | 0.2 | | 0.2 |
| BM | 5.0 | 0.30 | 0.02 | 2.0 | 5.0 | | 1.6 | 0.2 | | 0.2 |
| BC | 5.6 | 0.10 | | 1.4 | 2.7 | | 1.1 | 0.1 | | 0.1 |
| C | 5.8 | | | 1.1 | 3.1 | | 1.4 | 0.1 | | 0.1 |
| 2C1 | 5.8 | | | 5.8 | 30.2 | | 14.2 | 10.2 | 0.3 | 0.7 |
| 2C2 | 6.4 | | | 4.7 | 30.1 | | 14.6 | 9.6 | 0.4 | 0.7 |

CHEMICAL DATA (SURVEY)

| HORIZON | ELEC COND (MMHOS/CM) | % H2O AT SATUR |
|---|---|---|
| LH | | |
| AE | 0.2 | 26.0 |
| BM | 0.2 | 25.0 |
| BC | 0.2 | 24.0 |
| C | 0.2 | 23.0 |
| 2C1 | 0.2 | 77.0 |
| 2C2 | 0.2 | 74.0 |

PHYSICAL DATA (SURVEY)

| HORIZON | PARTICLE SIZE ANALYSIS % PASSING 3 SIEVE | .75 SIEVE | NO.4 SIEVE | NO.10 SIEVE | V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | % OF SAMPLE 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH | | | | | | | | | | | | | | |
| AE | | 99 | 95 | 90 | 9 | 16 | 23 | 30 | 11 | 89 | | 11 | 0 | |
| BM | | 88 | 70 | 59 | 14 | 12 | 19 | 38 | 12 | 95 | | 4 | 1 | |
| BC | | 99 | 87 | 70 | 24 | 19 | 20 | 30 | 6 | 99 | | 1 | 0 | |
| C | | 98 | 97 | 95 | 9 | 16 | 33 | 27 | 9 | 94 | | 5 | 1 | |
| 2C1 | | | | | | | | | | 4 | | 12 | 84 | |
| 2C2 | | | | | | | | | | 2 | | 16 | 82 | |

CNN MANITOBA 1980 PROFILE NO. 70

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PHYSICAL DATA

ENGINEERING

| HORIZON | ATTERBURG PLASTIC LIMIT (%) | ATTERBURG LIQUID LIMIT (%) | SHRINKAGE LIMIT (%) | OPT MOIST CONTENT (%) | MAX DRY DENSITY (G/CC) | COLE VALUE | AASHO CLASS | UNIFIED CLASS |
|---|---|---|---|---|---|---|---|---|
| LH | | | | | | | | |
| AE | | | | | | | | |
| BM | | | | | | | | |
| BC | | | | | | | | |
| C | | | | | | | | |
| 2C1 | | | | | | | | |
| 2C2 | 25.0 | 60.0 | 19.0 | | | | 76 | 13 |

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FYL MANITOBA 1981 PROFILE NO. 60

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF DETAILED SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: ELUVIATED DYSTRIC BRUNISOL. MINERAL SOIL FAMILY: SANDY SKELETAL, MIXED NONCLAY, ACID, COLD, SUBHUMID. SOIL MAP UNIT: TAXONOMIC SERIES, NOTATION: FYL.

LOCATION: MILITARY GRID REF. 14 ULR 1750 6990; NTS MAP AREA 63K 12W; NW 30 66 29 W.

CLIMATE: 1025 FEET ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON

VEGETATION: ASPEN,ALDER,CHAMAE DAPHNE,WILLOW.

SOIL SITE: PARENT MATERIAL 1: CHEMICAL AND PHYSICAL WEATHERING, SANDY, MEDIUM ACID TO NEUTRAL (PH 5.6-7.3), MORAINAL (TILL), IGNEOUS; LANDFORM CLASSIFICATION: MORAINAL, GRAVELLY, HUMMOCKY; SLOPE: 25% COMPLEX SLOPE OF CLASS 6 (16-30%), FACING SOUTHEAST, SITE AT CREST POSITION; SOIL MOISTURE AND DRAINAGE: SUBHUMID, RAPIDLY DRAINED, RAPIDLY PERVIOUS, MODERATE SURFACE RUNOFF, SEEPAGE ABSENT; MODERATELY STONY; NONROCKY; PRESENT LAND USE: MINES,QUARRIES,ETC.

SPECIAL NOTES: SITE IS THE WEST FACE OF AN ABANDONED GRAVEL PIT,WITH WILLOWS IN BOTTOM. GRAVELLY TILL. FAYE LAKE SERIES.

LH: 4 TO 0 CM; MATRIX DRY 10YR 2/2; ORGANIC; ABUNDANT, MEDIUM AND FINE, RANDOM ROOTS; MODERATELY POROUS.

AA: 0 TO 4 CM; MATRIX DRY 10YR 5/1; GRAVELLY LOAMY SAND; STRUCTURELESS STRUCTURE; PLENTIFUL, FINE, VERTICAL ROOTS; MODERATELY POROUS; 50% COARSE FRAGMENTS.

BM: 4 TO 30 CM; MATRIX MOIST 10YR 5/8; GRAVELLY LOAMY SAND; STRUCTURELESS STRUCTURE; PLENTIFUL, VERTICAL ROOTS; MODERATELY POROUS; 20% COARSE FRAGMENTS.

BC: 30 TO 50 CM; MATRIX MOIST 10YR 6/4; GRAVELLY LOAMY SAND; STRUCTURELESS STRUCTURE; VERY FEW, COARSE, VERTICAL ROOTS; MODERATELY POROUS; 20% COARSE FRAGMENTS.

C: 50 TO 100 CM; MATRIX MOIST 10YR 6/2; GRAVELLY LOAMY SAND; STRUCTURELESS STRUCTURE; VERY FEW, COARSE, VERTICAL ROOTS; MODERATELY POROUS; 10% COARSE FRAGMENTS.

CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | TOTAL N (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|
| LH | 4.5 | 35.59 | 0.83 | 55.4 | 75.0 | | 17.0 | 1.7 | 0.6 | 0.1 |
| AA | 4.4 | 0.50 | 0.03 | 2.5 | 4.0 | | 0.7 | 0.1 | 0.1 | 0.3 |
| BM | 4.6 | 0.26 | 0.02 | 3.0 | 4.3 | | 0.1 | 0.1 | 0.1 | 0.1 |
| BC | 4.8 | | | 2.0 | 2.7 | | 0.2 | 0.1 | | |
| C | 4.8 | | | 1.0 | 2.7 | | 0.9 | 0.1 | 0.1 | 0.1 |

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CHEMICAL DATA (SURVEY)

| HORIZON | EXTRACT IRON (%) 1 | EXTRACT IRON (%) 2 | ELEC COND (MMHOS/CM) | % H2O AT SATUR |
|---|---|---|---|---|
| LH | 0.6 | | | |
| AA | | | 0.2 | 25.3 |
| BM | | | 0.2 | 23.3 |
| BC | | | 0.2 | 18.8 |
| C | | | 0.2 | 16.7 |

PHYSICAL DATA (SURVEY)

PARTICLE SIZE ANALYSIS

| HORIZON | % PASSING 3 SIEVE | % PASSING .75 SIEVE | % PASSING NO.4 SIEVE | % PASSING NO.10 SIEVE | % OF SAMPLE V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH | | | | | | | | | | | | | | |
| AA | | | | 92 | 5 | 16 | 21 | 24 | 17 | 83 | | 14 | 3 | |
| BM | | 98 | 76 | 67 | 8 | 13 | 17 | 22 | 21 | 81 | | 17 | 2 | |
| BC | | 95 | 83 | 76 | 9 | 13 | 17 | 23 | 21 | 83 | | 14 | 3 | |
| C | | 94 | 85 | 79 | 8 | 11 | 15 | 23 | 19 | 76 | | 20 | 4 | |

PHYSICAL DATA

SURVEY (CON'T)

MOISTURE STATUS (%)

| HORIZON | 0.1 ATM | 0.33 ATM | 15 ATM | HYGR. MOIST | FIELD MOIST |
|---|---|---|---|---|---|
| LH | | | | | |
| AA | | | 1.5 | | |
| BM | | | | | |
| BC | | | | | |
| C | | | 1.2 | | |

FEB 06, 1987

HGX MANITOBA 1980 PROFILE NO. 71

IDENTIFICATION: SURVEYED BY RGE, PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: TYPIC MESISOL. ORGANIC SOIL FAMILY: SPHAGNIC, COLD, SUBAQUIC. SOIL MAP UNIT: COMPLEX.

LOCATION: MILITARY GRID REF. 14 ULR 1725 7251; NTS MAP AREA 63K 13W; SE 5 67 29 W.

CLIMATE: 1000 FEET ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON

VEGETATION: GRASSES AND FORBES.

SOIL SITE: PARENT MATERIAL 1: EXTREMELY TO STRONGLY ACIDIC (PH.5.5), ORGANIC, A430; ORGANIC DEPOSIT IS 3.7 M; LANDFORM CLASSIFICATION: FEN, MESIC, HORIZONTAL; SLOPE: 0% SIMPLE SLOPE OF CLASS 1 (0-0.5%); SOIL MOISTURE AND DRAINAGE: PERAQUIC; PRESENT LAND USE: BUILT-UP AREAS, FEN.

SPECIAL NOTES: DEEP ORGANIC, MAINLY GRASS VEG. WITH SOME SHRUBS NEAR EDGES FROZEN AT 35 TO 60 CM. AREA HAS NOW BEEN INFILLED FOR C OMMERCIAL DEVELOPMENT(1981)

OF: 0 TO 30 CM; MATERIAL COMPOSITION NO DECOMPOSITION; VON POST SCALE 01.

OM: 30 TO 60 CM; MATERIAL COMPOSITION SLIGHT DECOMPOSITION.

OM2: 60 TO 100 CM; MATERIAL COMPOSITION SLIGHT DECOMPOSITION.

OM3: 100 TO 150 CM; MATERIAL COMPOSITION SLIGHT DECOMPOSITION.

OM4: 150 TO 200 CM; MATERIAL COMPOSITION SLIGHT DECOMPOSITION; <10% BY VOLUME.

OM5: 200 TO 250 CM; MATERIAL COMPOSITION SLIGHT DECOMPOSITION.

OM6: 250 TO 300 CM; MATERIAL COMPOSITION MODERATE DECOMPOSITION.

OM7: 300 TO 375 CM; MATERIAL COMPOSITION MODERATE DECOMPOSITION.

2CG: 375 TO 400 CM; MATRIX MOIST 5Y 4/3; SILTY CLAY.

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CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | PYRO EXTR C-% | TOTAL N (%) | CALC CARB EQU.% | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OF | 4.3 | 57.25 | 16.0 | 1.70 | | 73.5 | 130.4 | | 43.7 | 14.3 | 0.5 | 0.7 |
| OM | 5.0 | 54.97 | 19.4 | 1.68 | | 71.5 | 163.3 | | 69.8 | 24.7 | 0.4 | 0.1 |
| OM2 | 5.2 | 56.11 | 19.5 | 1.60 | | 74.5 | 161.4 | | 58.9 | 25.0 | 0.3 | 0.1 |
| OM3 | 5.1 | 57.06 | 10.5 | 1.70 | | 75.5 | 162.8 | | 58.7 | 25.3 | 0.3 | 0.1 |
| OM4 | 5.0 | 57.44 | 11.9 | 1.83 | | 71.6 | 155.2 | | 60.0 | 25.4 | 0.3 | 0.1 |
| OM5 | 5.1 | 58.58 | 9.3 | 1.76 | | 71.6 | 157.1 | | 59.1 | 25.7 | 0.3 | 0.1 |
| OM6 | 5.3 | 59.05 | 7.7 | 1.85 | | 51.0 | 137.1 | | 61.3 | 24.2 | 0.4 | 0.1 |
| OM7 | 5.4 | 55.07 | 9.6 | 2.07 | | 49.4 | 123.3 | | 52.5 | 22.7 | 0.4 | 0.1 |
| 2CG | 6.9 | | | | 1.5 | 3.8 | 34.0 | | 20.2 | 8.5 | 0.3 | 0.7 |

PHYSICAL DATA (SURVEY)

| HORIZON | RUB FIB % | UNRUB FIBRE % | % ASH | % PASSING 3 SIEVE | .75 SIEVE | NO.4 SIEVE | NO.10 SIEVE | PARTICLE SIZE ANALYSIS V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | % OF SAMPLE 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OF | 74 | 90 | 9 | | | | | | | | | | | | | | |
| OM | 36 | 56 | 6 | | | | | | | | | | | | | | |
| OM2 | 42 | 58 | 7 | | | | | | | | | | | | | | |
| OM3 | 44 | 60 | 5 | | | | | | | | | | | | | | |
| OM4 | 36 | 64 | 6 | | | | | | | | | | | | | | |
| OM5 | 44 | 56 | 6 | | | | | | | | | | | | | | |
| OM6 | 36 | 52 | 6 | | | | | | | | | | | | | | |
| OM7 | 44 | 62 | 8 | | | | | | | | | | | | | | |
| 2CG | | | | | | | | | | | | | 5 | | 28 | .67 | |

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HGX MANITOBA 1980 PROFILE NO. 69

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF DETAILED SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: TYPIC MESISOL. SOIL MAP UNIT: NOTATION: HGX.

LOCATION: MILITARY GRID REF. 14 ULR 1800 7420; NTS MAP AREA 63K 13W; NW 9 67 29 W.

CLIMATE: 1100 FEET ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON

VEGETATION: LEDUM.

SOIL SITE: PARENT MATERIAL 1: MEDIUM ACID TO NEUTRAL (PH 5.6-7.3), ORGANIC; PARENT MATERIAL 2: FINE LOAMY AND FINE SILTY (18 TO 35% CLAY), WEAKLY CALCAREOUS (1 TO 6% CACO3), LACUSTRINE.

SPECIAL NOTES: PROFILE INDICATES SEVERAL SUCCESSIVE BURNS, PART OF HARGRAVE COMPLEX(HGX)

OF: 0 TO 25 CM; ORGANIC.

OM1: 25 TO 70 CM; MATERIAL COMPOSITION MODERATE DECOMPOSITION; ORGANIC.

OM2: 70 TO 125 CM; MATERIAL COMPOSITION MODERATE DECOMPOSITION; ORGANIC.

OM3: 125 TO 180 CM; MATERIAL COMPOSITION MODERATE DECOMPOSITION; ORGANIC.

OM4: 180 TO 200 CM; MATERIAL COMPOSITION MODERATE DECOMPOSITION; ORGANIC.

2CKG: 200 TO 250 CM; CLAY LOAM; WEAKLY CALCAREOUS.

CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | PYRO EXTR C-% | TOTAL N (%) | CALC CARB EQU.% | CAL-CITE (%) | DOLO-MITE (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OF | 3.0 | 56.87 | 29.0 | 0.85 | | | | 99.9 | 144.7 | | 15.8 | 5.1 | 0.1 | 0.5 |
| OM1 | 3.5 | 60.47 | 28.4 | 0.94 | | | | 99.9 | 164.7 | | 37.3 | 6.2 | 0.1 | 0.1 |
| OM2 | 4.2 | 59.15 | 25.0 | 1.02 | | | | 80.4 | 139.9 | | 45.6 | 8.5 | 0.1 | 0.1 |
| OM3 | 4.5 | 57.63 | 12.7 | 1.43 | | | | 74.5 | 127.5 | | 46.9 | 9.1 | 0.1 | 0.1 |
| OM4 | 4.7 | 46.45 | 12.9 | 1.76 | | | | 43.1 | 80.4 | | 27.4 | 7.6 | 0.1 | 0.1 |
| 2CKG | 7.5 | | | | 3.3 | 1.7 | 1.5 | | 14.0 | | 13.0 | 4.2 | 0.3 | 0.1 |

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PHYSICAL DATA (SURVEY)

| HORIZON | RUB FIB % | UNRUB FIBRE % | % ASH | % PASSING 3 SIEVE | .75 SIEVE | NO.4 SIEVE | NO.10 SIEVE | PARTICLE SIZE ANALYSIS V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | % OF SAMPLE 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OF | 76 | 86 | 5 | | | | | | | | | | | | | | |
| OM1 | 36 | 68 | 6 | | | | | | | | | | | | | | |
| OM2 | 30 | 60 | 7 | | | | | | | | | | | | | | |
| OM3 | 28 | 50 | 5 | | | | | | | | | | | | | | |
| OM4 | 20 | 40 | 23 | | | | | | | | | | | | | | |
| 2CKG | | | | | | | | | 1 | 2 | 6 | 14 | 23 | | 38 | 39 | |

FEB 06, 1987

MRD MANITOBA 1981 PROFILE NO. 59

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF DETAILED SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; LIMITED EXTENT; SURVEY REPORT NO. D.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: REGO GLEYSOL. MINERAL SOIL FAMILY: CLAYEY, MONTMORILLONITIC, NEUTRAL, COLD, AQUIC. SOIL MAP UNIT: TAXONOMIC SERIES, NOTATION: MRD, ASSOCIATED SOILS: ROEAND REX.

LOCATION: MILITARY GRID REF. 14 ULR 1700 7134; NTS MAP AREA 63K 13W; NW 31 66 29 W.

CLIMATE: 960 FEET ABOVE MEAN SEA LEVEL. STATION AT FLINFLON AIR.P.

VEGETATION: SEDGES,ASPEN,WILLOW.

SOIL SITE: PARENT MATERIAL 1: CHEMICAL AND PHYSICAL WEATHERING, CLAYEY (>35% CLAY), WEAKLY CALCAREOUS (1 TO 6% CACO3), LACUSTRINE; LANDFORM CLASSIFICATION: LACUSTRINE, CLAYEY, LEVEL; SLOPE: SIMPLE SLOPE OF CLASS 1 (0-0.5%), FACING LEVEL; SOIL MOISTURE AND DRAINAGE: AQUIC, POORLY DRAINED, SLOWLY PERVIOUS, VERY SLOW SURFACE RUNOFF, 1.2 M TO WATERTABLE; NONSTONY; NONROCKY; PRESENT LAND USE: FEN.

SPECIAL NOTES: SOME MINERAL MATERIAL IN THE SURFACE ORGANIC LAYER. RECENT FLOODING AND DISTURBANCE BY RAILWAY 20 METERS TO THE SOUTH. POROSITY DUE TO OLD ROOT CHANNELS(MEDARD SERIES)

OF: 30 TO 25 CM; MATRIX MOIST 10YR 3/2; ORGANIC; SMOOTH, CLEAR HORIZON BOUNDARY.

OM: 25 TO 10 CM; MATRIX MOIST 10YR 2/2; ORGANIC; SMOOTH, CLEAR HORIZON BOUNDARY.

OMOH: 10 TO 0 CM; MATRIX MOIST 2.5Y 2/0; ORGANIC; MEDIUM, PROMINENT MOTTLES; SMOOTH, CLEAR HORIZON BOUNDARY.

CG: 0 TO 50 CM; MATRIX MOIST 5Y 4/2; CLAY; COMMON, COARSE, PROMINENT, 2.5Y 5/4 MOTTLES; MASSIVE STRUCTURE; STICKY, VERY PLASTIC CONSISTENCE; FEW, MEDIUM, VERTICAL, INPED ROOTS; SLIGHTLY POROUS, COMMON, MEDIUM, VERTICAL, CONTINUOUS, SIMPLE, TUBULAR PORES; SMOOTH, CLEAR HORIZON BOUNDARY.

CG2: 50 TO 100 CM; MATRIX MOIST 5Y 5/1; CLAY; COMMON, 5YR 4/2 MOTTLES; MASSIVE STRUCTURE; STICKY, VERY PLASTIC CONSISTENCE; FEW, MEDIUM, VERTICAL, INPED ROOTS; SLIGHTLY POROUS, COMMON, MEDIUM, VERTICAL, CONTINUOUS, SIMPLE, TUBULAR PORES; SMOOTH, CLEAR HORIZON BOUNDARY.

CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | PYRO EXTR C-% | TOTAL N (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OF | 6.2 | 41.41 | 21.2 | 1.30 | 26.0 | 70.5 | | 39.3 | 15.2 | 2.2 | 1.1 |
| OM | 6.4 | 27.94 | 87.0 | 1.26 | 32.2 | 113.4 | | 66.0 | 21.4 | 0.4 | 0.9 |
| OMOH | 6.5 | 21.95 | 75.9 | 1.23 | 20.2 | 103.1 | | 55.5 | 16.4 | 0.3 | 0.4 |
| CG | 6.9 | | | | 4.3 | 25.6 | | 13.8 | 7.0 | 0.3 | 0.5 |
| CG2 | 6.9 | | | | 4.6 | 28.3 | | 14.9 | 6.9 | 0.2 | 0.5 |

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CHEMICAL DATA (SURVEY)

| HORIZON | ELEC COND (MMHOS/CM) | % H2O AT SATUR |
|---|---|---|
| OF | | |
| OM | | |
| OMOH | | |
| CG | 0.6 | 58.0 |
| CG2 | 0.3 | 61.4 |

PHYSICAL DATA (SURVEY)

| | | | | PARTICLE SIZE ANALYSIS | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | % PASSING | | | | | | | | | | % OF SAMPLE | | | |
| HORIZON | RUB FIB % | UNRUB FIBRE % | % ASH | 3 SIEVE | .75 SIEVE | NO.4 SIEVE | NO.10 SIEVE | V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
| OF | 26 | 48 | 37 | | | | | | | | | | | | | | |
| OM | 22 | 30 | 49 | | | | | | | | | | | | | | |
| OMOH | 16 | 38 | 59 | | | | | | | | | | | | | | |
| CG | | | | | | | | | | 1 | 3 | 18 | 22 | | 32 | 46 | |
| CG2 | | | | | | | | 1 | 1 | | 2 | 14 | 18 | | 33 | 49 | |

PHYSICAL DATA

| | SURVEY (CON'T) | | | | | | | ENGINEERING | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MOISTURE STATUS (%) | | | | | | | | | | | | |
| HORIZON | 0.1 ATM | 0.33 ATM | 15 ATM | HYGR. MOIST | FIELD MOIST | ATTERBURG PLASTIC LIMIT (%) | ATTERBURG LIQUID LIMIT (%) | SHRINKAGE LIMIT (%) | OPT MOIST CONTENT (%) | MAX DRY DENSITY (G/CC) | COLE VALUE | AASHO CLASS | UNIFIED CLASS |
| OF | | | | | 206.0 | | | | | | | | |
| OM | | | | | 239.0 | | | | | | | | |
| OMOH | | | | | 76.0 | | | | | | | | |
| CG | | | | | 30.0 | | | | | | | | |
| CG2 | | | | | 36.0 | 28.0 | 48.0 | 21.9 | | | | 76 | 09 |

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PCP MANITOBA 1981 PROFILE NO. 54

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF DETAILED SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; LIMITED EXTENT; SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: ELUVIATED DYSTRIC BRUNISOL. MINERAL SOIL FAMILY: SANDY SKELETAL, MIXED NONCLAY, ACID, COLD, SUBHUMID. SOIL MAP UNIT: TAXONOMIC SERIES, NOTATION: PCP, ASSOCIATED SOILS: CLK. SOIL PHASES: STRONGLY SLOPING AND MODERATELY STONY.

LOCATION: MILITARY GRID REF. 14 ULR 1750 7505; NTS MAP AREA 63K 13W; NE 8 67 29 W.

CLIMATE: 1100 FEET ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON AIR P HAS GOOD RELEVANCE TO THE SOIL SITE.

VEGETATION: FOREST,MIXED, REGENERATING. ASPEN,BIRCH,ALDER,BLUE BERRY.

SOIL SITE: PARENT MATERIAL 1: SANDY, MEDIUM ACID TO NEUTRAL (PH 5.6-7.3), FLUVIAL, COARSE ACID; LANDFORM CLASSIFICATION: FLUVIAL, COBBLY AND GRAVELLY; SLOPE: 25% COMPLEX SLOPE OF CLASS 6 (16-30%), SITE AT UPPER SLOPE POSITION; SOIL MOISTURE AND DRAINAGE: SEMIARID, RAPIDLY DRAINED, RAPIDLY PERVIOUS, SLOW SURFACE RUNOFF, SEEPAGE ABSENT; VERY STONY; PRESENT LAND USE: MINES,QUARRIES, ETC.

SPECIAL NOTES: WEST FACING ROAD CUT.FLUVIAL MATERIALS HIGH UP ON SIDE OF BEDROCK CHANNEL.MATERIALS ARE VERY STRATIFIED LAYERS OF COARSE COBBLY GRAVELS MIXED WITH SORTED SAND LAYERS.MOST MATERIALS IN THIS MAP UNIT HAVE BEEN MINED.PARTRIDGE CROP SERIES

LFH: 5 TO 0 CM, RANGE 2 TO 10 CM; HORIZON DRY; MATRIX MOIST 10YR 3/2; ORGANIC; ABUNDANT, VERY FINE AND MEDIUM, RANDOM, INPED ROOTS; SMOOTH, ABRUPT HORIZON BOUNDARY.

AE: 0 TO 4 CM, RANGE 1 TO 6 CM; HORIZON DRY; MATRIX MOIST 10YR 5/3; SAND; STRUCTURELESS, SINGLE GRAIN STRUCTURE; LOOSE, NONPLASTIC CONSISTENCE; ABUNDANT, FINE, VERTICAL, INPED ROOTS; 60% COARSE FRAGMENTS; SMOOTH, GRADUAL HORIZON BOUNDARY.

BM: 4 TO 30 CM, RANGE 10 TO 35 CM; HORIZON DRY; MATRIX MOIST 10YR 4/6; COARSE SAND; STRUCTURELESS, SINGLE GRAIN STRUCTURE; LOOSE, NONPLASTIC CONSISTENCE; PLENTIFUL, MEDIUM, VERTICAL, INPED ROOTS; 50% ANGULAR GRAVELLY COARSE FRAGMENTS; SMOOTH, GRADUAL HORIZON BOUNDARY.

C: 30 TO 70 CM; HORIZON DRY; MATRIX MOIST 10YR 5/6; SAND; STRUCTURELESS, SINGLE GRAIN STRUCTURE; LOOSE, NONPLASTIC CONSISTENCE; VERY FEW, COARSE, VERTICAL, INPED ROOTS; SMOOTH, CLEAR HORIZON BOUNDARY.

C2: 70 TO 100 CM; HORIZON MOIST; MATRIX DRY 10YR 5/6; SAND; STRUCTURELESS, SINGLE GRAIN STRUCTURE; SLIGHTLY HARD CONSISTENCE; INPED ROOTS.

CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | TOTAL N (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|
| LFH | 5.8 | 22.06 | 0.70 | 18.9 | 52.7 | | 29.9 | 1.9 | 0.3 | 0.4 |
| AE | 4.8 | 1.29 | 0.06 | 5.4 | 7.0 | | 1.2 | 0.3 | 0.1 | 0.2 |
| BM | 4.2 | 0.35 | 0.02 | 4.3 | 4.6 | | 0.3 | 0.1 | | 0.1 |
| C | 4.5 | | | 2.0 | 2.3 | | 0.2 | 0.1 | | 0.1 |
| C2 | 4.7 | | | 1.5 | 2.0 | | 0.2 | 0.1 | | |

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CHEMICAL DATA (SURVEY)

| HORIZON | ELEC COND (MMHOS/CM) | % H2O AT SATUR |
|---|---|---|
| LFH | | |
| AE | 0.2 | 34.9 |
| BM | 0.1 | 28.7 |
| C | 0.1 | 30.0 |
| C2 | 0.1 | 32.3 |

PHYSICAL DATA (SURVEY)

PARTICLE SIZE ANALYSIS

| HORIZON | % PASSING 3 SIEVE | .75 SIEVE | NO.4 SIEVE | NO.10 SIEVE | V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | % OF SAMPLE 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFH | | | | | | | | | | | | | | |
| AE | | | 97 | 96 | 3 | 22 | 28 | 22 | 10 | 85 | | 11 | 4 | |
| BM | | 80 | 70 | 67 | 11 | 33 | 30 | 14 | 6 | 94 | | 4 | 2 | |
| C | | | | 99 | 2 | 17 | 49 | 25 | 4 | 97 | | 1 | 2 | |
| C2 | | | | 99 | | 2 | 20 | 56 | 18 | 96 | | 2 | 2 | |

PHYSICAL DATA

SURVEY (CON'T)

MOISTURE STATUS (%)

| HORIZON | 0.1 ATM | 0.33 ATM | 15 ATM | HYGR. MOIST | FIELD MOIST |
|---|---|---|---|---|---|
| LFH | | | | | |
| AE | | | | | |
| BM | | | 1.1 | | |
| C | | | 0.9 | | |
| C2 | | | | | |

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PCP MANITOBA 1981 PROFILE NO. 56

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF DETAILED SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: ELUVIATED DYSTRIC BRUNISOL. MINERAL SOIL FAMILY: SANDY, MIXED NONCLAY, NEUTRAL, COLD, HUMID. SOIL MAP UNIT: TAXONOMIC SERIES, NOTATION: PCP, ASSOCIATED SOILS: WVT.

LOCATION: MILITARY GRID REF. 14 ULR 1714 6980; NTS MAP AREA 63K 12W; NW 30 66 29 W.

CLIMATE: 1000 ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON AIR P

VEGETATION: ASPEN, DOG WOOD,ALDER,FIREWEED,CORNIS CANADENSIS.

SOIL SITE: PARENT MATERIAL 1: CHEMICAL AND PHYSICAL WEATHERING, SANDY, MEDIUM ACID TO NEUTRAL (PH 5.6-7.3), FLUVIAL, IGNEOUS; LANDFORM CLASSIFICATION: FLUVIAL, SANDY, INCLINED; SLOPE: 15% COMPLEX SLOPE OF CLASS 5 (10-15%), FACING SOUTH, SITE AT UPPER SLOPE POSITION, 20 M LONG; SOIL MOISTURE AND DRAINAGE: HUMID, RAPIDLY DRAINED, RAPIDLY PERVIOUS, SLOW SURFACE RUNOFF; MODERATELY STONY; NONROCKY; PRESENT LAND USE: PRODUCTIVE WOODLAND.

SPECIAL NOTES: SITE ON SMALL BEDROCK TERRACE; NO BLACK SPRUCE; SURFACE DEPOSITS ARE STRATIFIED; RELIEF ON BEDROCK CONTROLED

LH: 25 TO 0 CM, RANGE 10 TO 25 CM; HORIZON MOIST; MATRIX MOIST 10YR 2/2; ORGANIC; ABUNDANT, MEDIUM, RANDOM, INPED ROOTS; HIGHLY POROUS; SMOOTH, CLEAR HORIZON BOUNDARY; MEDIUM ACID 5.6-6.0 FIELD PH.

AE: 0 TO 20 CM, RANGE 10 TO 20 CM; HORIZON MOIST; MATRIX MOIST 10YR 4/2; GRAVELLY SANDY CLAY LOAM; STRUCTURELESS, SINGLE GRAIN STRUCTURE; PLENTIFUL, FINE, VERTICAL, INPED ROOTS; HIGHLY POROUS; SMOOTH, CLEAR HORIZON BOUNDARY; MEDIUM ACID 5.6-6.0 FIELD PH.

BM: 20 TO 50 CM, RANGE 20 TO 40 CM; HORIZON MOIST; MATRIX MOIST 10YR 4/4; SAND; STRUCTURELESS STRUCTURE; FEW, FINE, VERTICAL, INPED ROOTS; HIGHLY POROUS; SMOOTH, GRADUAL HORIZON BOUNDARY; MEDIUM ACID 5.6-6.0 FIELD PH.

C: 50 TO 70 CM, RANGE 15 TO 25 CM; HORIZON MOIST; MATRIX MOIST 2.5Y 5/2; SANDY LOAM; FEW, MEDIUM, FAINT MOTTLES; MODERATE, FINE TO MEDIUM, PRISMATIC STRUCTURE; VERY FEW, FINE, VERTICAL, INPED ROOTS; HIGHLY POROUS; SMOOTH, CLEAR HORIZON BOUNDARY; MEDIUM ACID 5.6-6.0 FIELD PH.

C2: 70 TO 100 CM; HORIZON MOIST; GRAVELLY COARSE SAND; STRUCTURELESS STRUCTURE; HIGHLY POROUS; MEDIUM ACID 5.6-6.0 FIELD PH.

CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | TOTAL N (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|
| LH | 6.2 | 51.73 | 1.78 | 41.3 | 137.5 | | 91.7 | 6.0 | 0.2 | 2.0 |
| AE | 6.2 | 1.45 | 0.10 | 4.4 | 17.5 | | 6.6 | 7.7 | 0.2 | 0.3 |
| BM | 6.4 | 0.25 | 0.03 | 1.8 | 7.1 | | 3.6 | 0.4 | 0.1 | 0.1 |
| C | 6.4 | | | 2.5 | 9.4 | | 5.6 | 0.7 | 0.1 | 0.2 |
| C2 | 6.4 | | | 1.0 | 4.3 | | 3.3 | 0.4 | | |

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CHEMICAL DATA (SURVEY)

| HORIZON | ELEC COND (MMHOS/CM) | % H2O AT SATUR |
|---|---|---|
| LH | | |
| AE | 0.5 | 41.2 |
| BM | 0.4 | 26.2 |
| C | 0.5 | 23.8 |
| C2 | 0.4 | 18.2 |

PHYSICAL DATA (SURVEY)

PARTICLE SIZE ANALYSIS

| HORIZON | % PASSING 3 SIEVE | .75 SIEVE | NO.4 SIEVE | NO.10 SIEVE | V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | % OF SAMPLE 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH | | | | | | | | | | | | | | |
| AE | | | | | 5 | 6 | 11 | 22 | 12 | 56 | | 21 | 23 | |
| BM | | | | | 6 | 10 | 33 | 36 | 4 | 89 | | 4 | 7 | |
| C | | 99 | 95 | 93 | 3 | 8 | 18 | 21 | 15 | 65 | | 23 | 12 | |
| C2 | | 92 | 85 | 80 | 22 | 21 | 19 | 16 | 8 | 86 | | 7 | 7 | |

PHYSICAL DATA

| HORIZON | SURVEY (CON'T) MOISTURE STATUS (%) 0.1 ATM | 0.33 ATM | 15 ATM | HYGR. MOIST | FIELD MOIST | ENGINEERING ATTERBURG PLASTIC LIMIT (%) | ATTERBURG LIQUID LIMIT (%) | SHRINKAGE LIMIT (%) | OPT MOIST CONTENT (%) | MAX DRY DENSITY (G/CC) | COLE VALUE | AASHO CLASS | UNIFIED CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH | | | | | | | | | | | | | |
| AE | | | 7.0 | | | 20.0 | 28.0 | 17.6 | | | | 40 | 10 |
| BM | | | 2.2 | | | | | | | | | | |
| C | | | 4.0 | | | 15.0 | 17.0 | 14.8 | | | | 40 | 09 |
| C2 | | | | | | | | | | | | | |

FEB 06, 1987

REX MANITOBA 1981 PROFILE NO. 58

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF DETAILED SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; LIMITED EXTENT; SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: TERRIC MESISOL. SOIL MAP UNIT: TAXONOMIC SERIES, NOTATION: REX, ASSOCIATED SOILS: MRD.

LOCATION: MILITARY GRID REF. 14 ULR 1686 7134; NTS MAP AREA 63K 13W; NW 31 66 29 W.

CLIMATE: 960 FEET ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON AIR P

VEGETATION: SEDGES.

SOIL SITE: PARENT MATERIAL 1: ORGANIC; PARENT MATERIAL 2: CLAYEY (>35% CLAY), LACUSTRINE; PARENT MATERIAL 3: SANDY, FLUVIAL; LANDFORM CLASSIFICATION: FEN, MESIC, HORIZONTAL; SOIL MOISTURE AND DRAINAGE: 0.6 M TO WATERTABLE.

SPECIAL NOTES: SITE IS ADJACENT TO ROSS CREEK. THUS ACCOUNTING FOR SOME OF THE STRATIFIED MINERAL DEPOSITS. SITE HAS BEEN BURNED OCCASIONALLY. THERE ARE NUMEROUS WOOD FRAGMENTS IN THE SECOND LAYER.ORGANIC MATERIALS ARE LAYERED.REED LAKE

OF: 0 TO 25 CM, RANGE 10 TO 35 CM; MATRIX MOIST 10YR 2/2; MATERIAL COMPOSITION 85 AND 5 AND 10% SEDGE AND REED AND HERBACEOUS FRAGMENTS AND WOOD FRAGMENTS, SLIGHT DECOMPOSITION; SLIGHTLY HARD WOODY MATERIAL 2 CM THICK, <10% BY VOLUME; ORGANIC; ABUNDANT, COARSE AND MEDIUM, RANDOM ROOTS.

OM: 25 TO 60 CM, RANGE 20 TO 50 CM; MATRIX MOIST 10YR 3/2; MATERIAL COMPOSITION 85 AND 5 AND 10% SEDGE AND REED AND HERBACEOUS FRAGMENTS AND WOOD FRAGMENTS, MODERATE DECOMPOSITION; SLIGHTLY HARD WOODY MATERIAL 2 CM THICK, <10% BY VOLUME; ORGANIC; ABUNDANT, MEDIUM, RANDOM ROOTS.

2CG: 60 TO 80 CM, RANGE 20 TO 30 CM; MATRIX MOIST 5Y 2.5/2; CLAY; FEW, FINE, OBLIQUE ROOTS.

3CG: 80 TO 100 CM; MATRIX MOIST 2.5Y 4/2; COARSE SAND.

CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | PYRO EXTR C-% | TOTAL N (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OF | 5.5 | 49.06 | 66.0 | 1.97 | 52.9 | 130.4 | | 69.2 | 7.4 | 0.6 | 2.4 |
| OM | 5.3 | 50.23 | 92.0 | 2.02 | 64.4 | 161.6 | | 82.6 | 18.5 | 0.2 | 2.4 |
| 2CG | 5.5 | | | | 12.2 | 36.7 | | 17.6 | 8.4 | 1.0 | 0.2 |
| 3CG | 5.7 | | | | 1.2 | 3.6 | | 1.8 | 0.7 | 0.2 | 0.3 |

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CHEMICAL DATA (SURVEY)

| HORIZON | ELEC COND (MMHOS/CM) | % H2O AT SATUR | WATER EXTRACT DETERMINATIONS CA | MG | NA | K | CO3 | HCO3 | CL | SO4 | NO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OF | | | | | | | | | | | |
| OM | | | | | | | | | | | |
| 2CG | 1.5 | 66.9 | | | | | | | | | |
| 3CG | 2.0 | 28.3 | 10.2 | 8.0 | 4.2 | | | 2.3 | | | |

CHEMICAL DATA (FERTILITY)

| HORIZON | INORGANIC AVAILABLE P | ORGANIC P |
|---|---|---|
| OF | | |
| OM | | |
| 2CG | | |
| 3CG | 3.0 | 13.2 |

PHYSICAL DATA (SURVEY)

| HORIZON | RUB FIB % | UNRUB FIBRE % | % ASH | % PASSING 3 SIEVE | .75 SIEVE | NO.4 SIEVE | NO.10 SIEVE | PARTICLE SIZE ANALYSIS V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | % OF SAMPLE 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OF | 34 | 52 | 18 | | | | | | | | | | | | | | |
| OM | 34 | 54 | 18 | | | | | | | | | | | | | | |
| 2CG | | | | | | | | | | 1 | 10 | 15 | 26 | | 28 | 46 | |
| 3CG | | | | | | | | 11 | 29 | 41 | 13 | 2 | 96 | | 1 | 3 | |

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REX MANITOBA 1981 PROFILE NO. 58

PHYSICAL DATA

| HORIZON | SURVEY (CON'T) MOISTURE STATUS (%) 0.1 ATM | 0.33 ATM | 15 ATM | HYGR. MOIST | FIELD MOIST | ENGINEERING ATTERBURG PLASTIC LIMIT (%) | ATTERBURG LIQUID LIMIT (%) | SHRINKAGE LIMIT (%) | OPT MOIST CONTENT (%) | MAX DRY DENSITY (G/CC) | COLE VALUE | AASHO CLASS | UNIFIED CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OF | | | | | 406.0 | | | | | | | | |
| OM | | | | | 371.0 | | | | | | | | |
| 2CG | | | | | 50.0 | 36.0 | 51.0 | 27.0 | | | | 75 | 12 |
| 3CG | | | | | 19.0 | | | | | | | | |

FEB 06, 1987

RLX MANITOBA 1981 PROFILE NO. 53

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF DETAILED SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: TYPIC MESISOL. ORGANIC SOIL FAMILY: COLD. SOIL MAP UNIT: COMPLEX, NOTATION: RLX.

LOCATION: MILITARY GRID REF. 14 ULR 1875 7722; NTS MAP AREA 63K ; C 21 67 29 W.

CLIMATE: 1100 FEET ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON

SOIL SITE: PARENT MATERIAL 1: EXTREMELY TO STRONGLY ACIDIC (PH.5.5), ORGANIC, A430; LANDFORM CLASSIFICATION: HORIZONTAL; SOIL MOISTURE AND DRAINAGE: POORLY DRAINED, 0.3 M TO WATERTABLE; PRESENT LAND USE: FEN.

SPECIAL NOTES: BOG BIRCH:PAPER BIRCH;HORSETAIL;SEDGE;LEDUM MINER.AQUATIC PEAT AT 360 CM. ROCK ISLAND SERIES

OM: 0 TO 25 CM; MATRIX MOIST 10YR 2/1; ORGANIC.

OF: 25 TO 50 CM; MATRIX MOIST 10YR 3/6; ORGANIC.

OM: 50 TO 200 CM; MATRIX MOIST 10YR 2/2; ORGANIC.

OM2: 200 TO 360 CM; MATRIX MOIST 10YR 2/2; ORGANIC.

OH: 360 TO 400 CM; MATRIX MOIST 5YR 2/2; ORGANIC.

OH2: 400 TO 450 CM; MATRIX MOIST 2.5Y 3/2; ORGANIC.

OH3: 450 TO 500 CM; ORGANIC.

CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | PYRO EXTR C-% | TOTAL N (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| OM | 5.5 | 57.88 | 26.1 | 1.44 | 51.0 | 198.9 | | 95.0 | 11.5 | 0.3 | 0.3 |
| OF | 5.5 | 58.21 | 4.9 | 0.88 | 30.3 | 114.8 | | 81.7 | 12.6 | 0.4 | 0.3 |
| OM | 5.4 | 61.04 | 8.6 | 1.76 | 42.8 | 150.5 | | 80.8 | 9.0 | 0.2 | 0.1 |
| OM2 | 5.4 | 60.21 | 12.0 | 2.00 | 49.5 | 134.8 | | 72.5 | 7.5 | 0.3 | 0.1 |
| OH | | | 6.9 | | 48.6 | 88.0 | | 45.8 | 5.3 | 0.8 | 0.6 |
| OH2 | | | 4.7 | | | | | | | | |
| OH3 | | | | | | | | | | | |

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PHYSICAL DATA (SURVEY)

| HORIZON | RUB FIB % | UNRUB FIBRE % | % ASH |
|---|---|---|---|
| OM | 50 | 80 | 9 |
| OF | 88 | 98 | 5 |
| OM | 50 | 68 | 6 |
| OM2 | 48 | 58 | 5 |
| OH | 30 | 62 | 19 |
| OH2 | | | 74 |
| OH3 | | | |

SWK MANITOBA 1981 PROFILE NO. 57

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF DETAILED SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: ORTHIC GRAY LUVISOL. SOIL MAP UNIT: TAXONOMIC SERIES, NOTATION: SWK, ASSOCIATED SOILS: WBWAND ROE.

LOCATION: MILITARY GRID REF. 14 ULR 1742 6846; NTS MAP AREA 63K 12W; NW 19 66 29 W.

CLIMATE: 1030 FEET ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON AIR P HAS GOOD RELEVANCE TO THE SOIL SITE.

VEGETATION: ASPEN, ALDER, FEW WILLOWS.

SOIL SITE: PARENT MATERIAL 1: CHEMICAL AND PHYSICAL WEATHERING, CLAYEY (>35% CLAY), MODERATELY TO VERY STRONGLY CALCAREOUS (6-40% CACO3), LACUSTRINE; DEPTH TO BEDROCK IS 1.6 M; LANDFORM CLASSIFICATION: LACUSTRINE, CLAYEY, BLANKET; SLOPE: SIMPLE SLOPE OF CLASS 1 (0-0.5%), FACING LEVEL; SOIL MOISTURE AND DRAINAGE: HUMID, WELL DRAINED, SLOWLY PERVIOUS, SLOW SURFACE RUNOFF, SEEPAGE ABSENT; NONSTONY; NONROCKY; PRESENT LAND USE: PRODUCTIVE WOODLAND.

SPECIAL NOTES: ROAD SIDE EXCAVATION,WEST EXPOSURE,FACE VERY DRY.SOME OVERBUREN ON SURFACE. AE IS THICKER THAN NORMAL FOR SIPIWESK STRUCTURE. IN B, ALTHOUGH TOUGH, IS NOT THE SAME AS WABOWDEN.

LFH: 10 TO 0 CM, RANGE 4 TO 20 CM; HORIZON DRY; 10YR 2/2; ORGANIC; STRUCTURELESS STRUCTURE; LOOSE CONSISTENCE; ABUNDANT, MEDIUM, RANDOM, INPED ROOTS; HIGHLY POROUS, MANY, RANDOM, INPED, CONTINUOUS PORES; SMOOTH, CLEAR HORIZON BOUNDARY; SLIGHTLY ACID 6.1-6.5 FIELD PH.

AC: 0 TO 24 CM, RANGE 15 TO 30 CM; HORIZON DRY; EXPED DRY 10YR 7/2; LOAMY SAND; VERY WEAK, VERY FINE TO FINE, PLATY STRUCTURE; SOFT CONSISTENCE; FEW, FINE, RANDOM, INPED ROOTS; HIGHLY POROUS, MANY, RANDOM, INPED, CONTINUOUS, TUBULAR PORES; SMOOTH, CLEAR HORIZON BOUNDARY; NEUTRAL 6.6-7.3 FIELD PH.

AB: 24 TO 40 CM, RANGE 10 TO 30 CM; HORIZON DRY; EXPED DRY 10YR 6/3; CLAY; STRONG, MEDIUM, PRISMATIC STRUCTURE; STRONG, MEDIUM, ANGULAR BLOCKY SECONDARY STRUCTURE; VERY HARD, VERY PLASTIC CONSISTENCE; VERY FEW, VERY FINE, VERTICAL, EXPED ROOTS; HIGHLY POROUS, FEW, FINE, RANDOM, INPED, CONTINUOUS, TUBULAR AND CRACKS AND FISSURE PORES; MANY, THIN CLAY FILMS ON PED FACES-UNSPECIFIED; SMOOTH, CLEAR HORIZON BOUNDARY; NEUTRAL 6.6-7.3 FIELD PH.

BT: 40 TO 80 CM, RANGE 30 TO 50 CM; MATRIX MOIST 10YR 3/3, INPED DRY 10YR 4/4; CLAY; STRONG, MEDIUM TO COARSE, PRISMATIC STRUCTURE; STRONG, MEDIUM TO COARSE, ANGULAR BLOCKY SECONDARY STRUCTURE; VERY HARD, VERY PLASTIC CONSISTENCE; VERY FEW, VERY FINE, VERTICAL, EXPED ROOTS; MODERATELY POROUS, FEW, FINE, HORIZONTAL, INPED, CONTINUOUS, TUBULAR AND CRACKS AND FISSURE PORES; CONTINUOUS, MODERATELY THICK CLAY FILMS ON PED FACES-UNSPECIFIED, 10YR 3/3; WAVY, GRADUAL HORIZON BOUNDARY; NEUTRAL 6.6-7.3 FIELD PH.

BC: 80 TO 95 CM, RANGE 10 TO 20 CM; MATRIX MOIST 10YR 4/2; CLAY; WEAK TO MODERATE, FINE TO MEDIUM, PRISMATIC STRUCTURE; MODERATE TO STRONG, FINE TO MEDIUM, GRANULAR SECONDARY STRUCTURE; VERY HARD, VERY PLASTIC CONSISTENCE; MODERATELY POROUS, VERY FEW, VERY FINE, HORIZONTAL, INPED, CONTINUOUS, CRACKS AND FISSURE PORES; MANY, CLAY FILMS ON PED FACES-UNSPECIFIED, 10YR 3/3; MANY, MEDIUM, IRREGULAR LIME CONCRETIONS LOCATED LOCAL CONCENTRATIONS (10YR 8/1); MODERATE EFFERVESCENCE; STRONGLY CALCAREOUS; WAVY, GRADUAL HORIZON BOUNDARY; MODERATELY ALKALINE 7.9-8.4 FIELD PH.

CK: 95 TO 120 CM; MATRIX MOIST 2.5Y 4/2; CLAY; VERY PLASTIC CONSISTENCE; SLIGHTLY POROUS, VERY FEW, MICRO, EXPED PORES; MANY, MEDIUM, IRREGULAR LIME CONCRETIONS LOCATED LOCAL CONCENTRATIONS (10YR 8/1); MODERATE EFFERVESCENCE; STRONGLY CALCAREOUS; MODERATELY ALKALINE 7.9-8.4 FIELD PH.

CK2: 120 TO 160 CM; MATRIX MOIST 2.5Y 4/2; SILTY CLAY; VERY PLASTIC CONSISTENCE; SLIGHTLY POROUS, VERY FEW, MICRO, EXPED PORES; COMMON, FINE, IRREGULAR LIME CONCRETIONS LOCATED LOCAL CONCENTRATIONS ; MODERATE EFFERVESCENCE; STRONGLY CALCAREOUS.

R: 160 CM

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CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | TOTAL N (%) | CALC CARB EQU.% | CAL-CITE (%) | DOLO-MITE (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFH | 4.4 | 46.24 | 1.42 | | | | 65.4 | 106.3 | | 25.0 | 5.9 | 0.6 | 2.4 |
| AC | 4.3 | 0.13 | 0.03 | | | | 2.8 | 3.8 | | 0.8 | 0.4 | 0.1 | 0.2 |
| AB | 4.9 | 0.34 | 0.04 | | | | 7.8 | 28.8 | | 5.8 | 13.5 | 0.2 | 0.3 |
| BT | 5.7 | 0.27 | 0.04 | | | | 4.2 | 28.6 | | 8.1 | 16.0 | 0.5 | 0.6 |
| BC | 6.9 | | | 6.9 | 4.7 | 2.0 | | 27.0 | | 14.7 | 13.2 | 0.4 | 0.4 |
| CK | 7.7 | | | 9.5 | 7.8 | 1.5 | | 27.3 | | 14.6 | 13.0 | 0.8 | 0.5 |
| CK2 | 7.7 | | | 8.2 | 6.3 | 1.7 | | 17.6 | | 18.1 | 8.4 | 0.2 | 0.2 |
| R | | | | | | | | | | | | | |

CHEMICAL DATA (SURVEY)

| HORIZON | ELEC COND (MMHOS/CM) | % H2O AT SATUR |
|---|---|---|
| LFH | | |
| AC | 0.6 | 19.0 |
| AB | 0.5 | 44.5 |
| BT | 0.8 | 59.7 |
| BC | 0.1 | 62.5 |
| CK | 1.4 | 62.6 |
| CK2 | 0.6 | 67.3 |
| R | | |

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SWK MANITOBA 1981 PROFILE NO. 57

PHYSICAL DATA (SURVEY)

PARTICLE SIZE ANALYSIS

| HORIZON | % PASSING 3 SIEVE | .75 SIEVE | NO.4 SIEVE | NO.10 SIEVE | V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | % OF SAMPLE 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFH | | | | | | | | | | | | | | |
| AE | | | | 98 | 2 | 3 | 5 | 38 | 31 | 79 | | 15 | 6 | |
| AB | | | | | | | 1 | 4 | 7 | 12 | | 40 | 48 | |
| BT | | | | | | 1 | 1 | 4 | 5 | 11 | | 33 | 56 | |
| BC | | | | | | | | | | 5 | | 29 | 66 | |
| CK | | | | | | | | | | 5 | | 40 | 55 | |
| CK2 | | | | | | | | | | 7 | | 47 | 46 | |
| R | | | | | | | | | | | | | | |

PHYSICAL DATA

SURVEY (CON'T)

ENGINEERING

| HORIZON | MOISTURE STATUS (%) 0.1 ATM | 0.33 ATM | 15 ATM | HYGR. MOIST | FIELD MOIST | ATTERBURG PLASTIC LIMIT (%) | ATTERBURG LIQUID LIMIT (%) | SHRINKAGE LIMIT (%) | OPT MOIST CONTENT (%) | MAX DRY DENSITY (G/CC) | COLE VALUE | AASHO CLASS | UNIFIED CLASS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFH | | | | | | | | | | | | | |
| AE | | | 1.7 | | | | | | | | | | |
| AB | | | | | | | | | | | | | |
| BT | | | 16.2 | | | 23.0 | 47.0 | 16.8 | | | | 76 | 10 |
| BC | | | | | | | | | | | | | |
| CK | | | 16.4 | | | | | | | | | | |
| CK2 | | | | | | 21.0 | 44.0 | 21.7 | | | | 76 | 10 |
| R | | | | | | | | | | | | | |

FEB 06, 1987

WBW MANITOBA 1980 PROFILE NO. 68

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF DETAILED SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; LIMITED EXTENT; SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: SOLONETZIC GRAY LUVISOL. MINERAL SOIL FAMILY: FINE CLAYEY, ALKALINE, WEAKLY CALCAREOUS, HUMID. SOIL MAP UNIT: TAXONOMIC SERIES.

LOCATION: MILITARY GRID REF. 14 ULR 1940 7405; NTS MAP AREA 63K 13W; SW 10 67 29 W.

CLIMATE: 1100 FEET ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON HAS GOOD RELEVANCE TO THE SOIL SITE.

SOIL SITE: PARENT MATERIAL 1: CLAYEY (>35% CLAY), WEAKLY CALCAREOUS (1 TO 6% CACO3), LACUSTRINE; LANDFORM CLASSIFICATION: LACUSTRINE, CLAYEY, UNDULATING; SLOPE: 10% SIMPLE SLOPE OF CLASS 5 (10-15%), FACING EAST, SITE AT MIDDLE POSITION; SOIL MOISTURE AND DRAINAGE: HUMID, MODERATELY WELL DRAINED, SLOWLY PERVIOUS, SLOW SURFACE RUNOFF; NONSTONY; NONROCKY; PRESENT LAND USE: PRODUCTIVE WOODLAND.

LH: 15 TO 0 CM; ORGANIC.

AE: 0 TO 12 CM; MATRIX DRY 2.5Y 3.5/2; SILTY CLAY LOAM; MODERATE, MEDIUM TO COARSE, PLATY STRUCTURE; SOFT, SLIGHTLY PLASTIC CONSISTENCE; .

AB: 12 TO 20 CM; MATRIX DRY 5Y 4.5/2; CLAY; MODERATE TO STRONG, VERY COARSE, ANGULAR BLOCKY STRUCTURE; FRIABLE, SLIGHTLY PLASTIC CONSISTENCE; FEW, MEDIUM, RANDOM, INPED, CONTINUOUS, DENDRITIC, TUBULAR PORES.

BT: 20 TO 60 CM; MATRIX MOIST 5Y 4/1; CLAY; MODERATE TO STRONG, VERY COARSE, PRISMATIC STRUCTURE; FIRM, SLIGHTLY PLASTIC CONSISTENCE; SLIGHTLY POROUS, FEW, FINE, VERTICAL, INPED, CONTINUOUS, DENDRITIC, TUBULAR PORES.

BC: 60 TO 75 CM; MATRIX MOIST 5Y 4/2; CLAY; MEDIUM, SUBANGULAR BLOCKY STRUCTURE; FIRM, PLASTIC CONSISTENCE; VERY FEW, FINE, VERTICAL, INPED, CONTINUOUS, DENDRITIC, TUBULAR PORES.

C: 75 TO 100 CM; MATRIX MOIST 5Y 4/1.5; CLAY; FIRM, PLASTIC CONSISTENCE; VERY FEW, FINE, VERTICAL, INPED, CONTINUOUS, DENDRITIC, TUBULAR PORES; VERY WEAK EFFERVESCENCE; WEAKLY CALCAREOUS.

CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | TOTAL N (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|
| LH | 5.3 | 37.73 | 1.35 | 30.5 | 72.3 | | 29.6 | 8.5 | 0.2 | 2.7 |
| AE | 5.4 | 1.81 | 0.13 | 8.5 | 20.3 | | 7.7 | 3.0 | 0.1 | 0.4 |
| AB | 5.3 | 1.09 | 0.08 | 7.2 | 18.9 | | 8.0 | 3.5 | 0.1 | 0.5 |
| BT | 5.4 | 0.57 | 0.06 | 7.6 | 29.3 | | 15.3 | 7.8 | 0.1 | 0.7 |
| BC | 6.2 | 0.32 | 0.04 | 5.8 | 27.1 | | 16.2 | 8.7 | 0.2 | 0.6 |
| C | 6.5 | | | 5.7 | 23.8 | | 14.9 | 8.3 | 0.2 | 0.5 |

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CHEMICAL DATA (SURVEY)

| HORIZON | ELEC COND (MMHOS/CM) | % H2O AT SATUR |
|---|---|---|
| LH | | |
| AE | 0.2 | 61.0 |
| AB | 0.2 | 42.0 |
| BT | 0.2 | 47.0 |
| BC | 0.2 | 50.0 |
| C | 0.2 | 53.0 |

PHYSICAL DATA (SURVEY)

PARTICLE SIZE ANALYSIS

| HORIZON | % PASSING 3 SIEVE | .75 SIEVE | NO.4 SIEVE | NO.10 SIEVE | V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | % OF SAMPLE 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH | | | | | | | | | | | | | | |
| AE | | | | | 2 | 2 | 4 | 6 | 5 | 19 | | 45 | 36 | |
| AB | | | | | 1 | 2 | 6 | 8 | 6 | 23 | | 36 | 41 | |
| BT | | | | | | | | | | 8 | | 20 | 72 | |
| BC | | | | | | | | | | 6 | | 29 | 65 | |
| C | | | | | | | | | | 5 | | 39 | 56 | |

PHYSICAL DATA

ENGINEERING

| HORIZON | ATTERBURG PLASTIC LIMIT (%) | ATTERBURG LIQUID LIMIT (%) | SHRINKAGE LIMIT (%) | OPT MOIST CONTENT (%) | MAX DRY DENSITY (G/CC) | COLE VALUE | AASHO CLASS | UNIFIED CLASS |
|---|---|---|---|---|---|---|---|---|
| LH | | | | | | | | |
| AE | | | | | | | | |
| AB | | | | | | | | |
| BT | | | | | | | | |
| BC | | | | | | | | |
| C | 22.0 | 43.0 | 17.0 | | | | 76 | 10 |

FEB 06, 1987

WVT MANITOBA 1980 PROFILE NO. 74

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF DETAILED SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; EXTENSIVE; SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: ELUVIATED DYSTRIC BRUNISOL. MINERAL SOIL FAMILY: SANDY, ACID, COLD, HUMID. SOIL MAP UNIT: TAXONOMIC SERIES, NOTATION: WVT, ASSOCIATED SOILS: BRAND FLK. SOIL PHASES: VERY GENTLY SLOPING AND VERY STONY AND EXCEEDINGLY ROCKY.

LOCATION: MILITARY GRID REF. 14 ULR 1768 7282; NTS MAP AREA 63K 13W; NW 4 67 29 W.

CLIMATE: 1000 FEET ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON

VEGETATION: BIRCH, ASPEN, JACK PINE.

SOIL SITE: PARENT MATERIAL 1: CHEMICAL AND PHYSICAL WEATHERING, COARSE LOAMY AND COARSE SILTY (<18% CLAY), MEDIUM ACID TO NEUTRAL (PH 5.6-7.3), MORAINAL (TILL), METAMORPHIC AND SCHIST AND PHYLLITE; DEPTH TO BEDROCK IS 0.9 M; LANDFORM CLASSIFICATION: BEDROCK, BOULDERY, VENEER; SLOPE: CLASS 2 (0.5-2%), FACING SOUTH, SITE AT MIDDLE POSITION, 50 M LONG; SOIL MOISTURE AND DRAINAGE: HUMID, RAPIDLY DRAINED, RAPIDLY PERVIOUS; VERY STONY; VERY ROCKY; PRESENT LAND USE: ROCKLAND.

SPECIAL NOTES: SAMPLE SITE IS AN INFILLED CREVASS IN BEDROCK -WOLVERTON SERIES.

LH: 2 TO 0 CM; MATRIX DRY 10YR 3/2; ORGANIC; STRUCTURELESS STRUCTURE; ABUNDANT, FINE, HORIZONTAL, INPED ROOTS; HIGHLY POROUS, MANY, INTERSTITIAL PORES; SMOOTH, ABRUPT HORIZON BOUNDARY.

AE: 0 TO 10 CM, RANGE 2 TO 12 CM; MATRIX MOIST 10YR 6/1; LOAMY SAND; STRUCTURELESS, SINGLE GRAIN STRUCTURE; FEW, MEDIUM, HORIZONTAL, INPED ROOTS; HIGHLY POROUS, MANY, INTERSTITIAL PORES; 20% ANGULAR COBBLY COARSE FRAGMENTS; SMOOTH, ABRUPT HORIZON BOUNDARY.

BM: 10 TO 25 CM, RANGE 10 TO 20 CM; MATRIX MOIST 10YR 5/6; LOAMY SAND; STRUCTURELESS, GRANULAR STRUCTURE; FEW, MEDIUM, OBLIQUE, INPED ROOTS; HIGHLY POROUS, MANY, INTERSTITIAL PORES; 30% ANGULAR COBBLY COARSE FRAGMENTS; WAVY, CLEAR HORIZON BOUNDARY.

BC: 25 TO 40 CM, RANGE 10 TO 20 CM; MATRIX MOIST 10YR 6/6; LOAMY SAND; STRUCTURELESS, GRANULAR STRUCTURE; VERY FEW, MEDIUM, OBLIQUE, INPED ROOTS; HIGHLY POROUS, MANY, INTERSTITIAL PORES; 50% ANGULAR COBBLY COARSE FRAGMENTS; WAVY, GRADUAL HORIZON BOUNDARY.

C: 40 TO 90 CM; MATRIX MOIST 10YR 6/4; LOAMY SAND; STRUCTURELESS, SINGLE GRAIN STRUCTURE; VERY FEW, MEDIUM, OBLIQUE, INPED ROOTS; HIGHLY POROUS, MANY, INTERSTITIAL PORES; 50% ANGULAR COBBLY COARSE FRAGMENTS; IRREGULAR, ABRUPT HORIZON BOUNDARY.

2R: 90 CM; MATRIX MOIST .

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CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | TOTAL N (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|
| LH | 4.5 | 19.72 | 0.70 | 29.8 | 39.4 | | 4.6 | 1.2 | 0.1 | 0.4 |
| AE | 4.3 | 1.64 | 0.07 | 5.4 | 7.6 | | 1.1 | 0.1 | | 0.1 |
| BM | 4.3 | 0.80 | 0.05 | 7.0 | 9.3 | | 1.2 | 0.1 | | |
| BC | 4.7 | 0.80 | 0.05 | 7.3 | 9.7 | | 0.4 | | | |
| C | 4.8 | | | 5.2 | 7.2 | | 0.5 | | | |
| 2R | | | | | | | | | | |

CHEMICAL DATA (SURVEY)

| HORIZON | ELEC COND (MMHOS/CM) | % H2O AT SATUR |
|---|---|---|
| LH | 0.6 | 190.0 |
| AE | 0.3 | 27.0 |
| BM | 0.2 | 29.0 |
| BC | 0.1 | 28.0 |
| C | 0.1 | 26.0 |
| 2R | | |

PHYSICAL DATA (SURVEY)

| HORIZON | PARTICLE SIZE ANALYSIS % PASSING 3 SIEVE | .75 SIEVE | NO.4 SIEVE | NO.10 SIEVE | V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | % OF SAMPLE 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LH | | | | | | | | | | | | | | |
| AE | | 96 | 91 | 90 | 7 | 11 | 16 | 27 | 19 | 80 | | 18 | 2 | |
| BM | | 88 | 82 | 81 | 10 | 11 | 14 | 27 | 15 | 77 | | 19 | 4 | |
| BC | | 99 | 90 | 82 | 13 | 14 | 16 | 22 | 19 | 84 | | 15 | 1 | |
| C | | 97 | 87 | 82 | 11 | 17 | 18 | 20 | 17 | 83 | | 16 | 1 | |
| 2R | | | | | | | | | | | | | | |

FEB 06, 1987

WVT MANITOBA 1981 PROFILE NO. 61

IDENTIFICATION: SURVEYED BY RGE, FOR THE PURPOSE OF EXPLORATORY SURVEY; PROVINCIAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; LIMITED EXTENT; SURVEY REPORT NO. D48.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: ORTHIC DYSTRIC BRUNISOL. MINERAL SOIL FAMILY: SANDY, SILICEOUS, VERY SHALLOW LITHIC, ACID, COLD, HUMID. SOIL MAP UNIT: TAXONOMIC SERIES. NOTATION: WVT.

LOCATION: MILITARY GRID REF. 14 ULR 1625 7735; NTS MAP AREA 63K 13W; SW 20 67 29 W.

CLIMATE: 1115 FEET ABOVE MEAN SEA LEVEL. STATION AT FLIN FLON

VEGETATION: STUNTED BLACK SPRUCE,BLUE BERRY, LEDUM.

SOIL SITE: PARENT MATERIAL 1: WEAK CHEMICAL WEATHERING, SANDY, MEDIUM ACID TO NEUTRAL (PH 5.6-7.3), LACUSTRO-TILL, COARSE ACID; DEPTH TO BEDROCK IS 0.5 M; LANDFORM CLASSIFICATION: SANDY, VENEER; SLOPE: 5% SLOPE , 20 M LONG; SOIL MOISTURE AND DRAINAGE: HUMID, WELL DRAINED, MODERATELY PERVIOUS, MODERATE SURFACE RUNOFF, SEEPAGE ABSENT; EXCEEDINGLY ROCKY; PRESENT LAND USE: PRODUCTIVE WOODLAND.

SPECIAL NOTES: SOIL DEVELOPED IN REMNANT P.M OF TILL THAT LODGED IN BED. ROCK CREVASSES WVT= WOLVERTON SERIES.

LFH: 4 TO 0 CM; ORGANIC; WAVY, ABRUPT HORIZON BOUNDARY.

BM: 0 TO 20 CM; SANDY LOAM; STRUCTURELESS STRUCTURE; WAVY, GRADUAL HORIZON BOUNDARY.

C: 20 TO 50 CM; SANDY LOAM; STRUCTURELESS STRUCTURE.

R: 50 CM

CHEMICAL DATA (SURVEY)

| HORIZON | PH 1 | ORG C (%) | TOTAL N (%) | EXTR ACID | C.E.C. (ME/100G) BUFF. | C.E.C. (ME/100G) PERM. CHARG | EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA | MG | NA | K |
|---|---|---|---|---|---|---|---|---|---|---|
| LFH | 3.7 | 38.09 | 0.63 | 76.9 | 86.2 | | 4.2 | 0.1 | 0.1 | 0.3 |
| BM | 4.2 | 2.26 | 0.11 | 13.1 | 21.6 | | 0.5 | 0.1 | 0.1 | 0.3 |
| C | 4.4 | | | 11.2 | 18.5 | | 0.5 | 0.2 | 0.1 | 0.4 |
| R | | | | | | | | | | |

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CHEMICAL DATA (SURVEY)

| HORIZON | ELEC COND (MMHOS/CM) | % H2O AT SATUR |
|---|---|---|
| LFH | | |
| BM | 0.1 | 46.8 |
| C | 0.1 | 33.0 |
| R | | |

PHYSICAL DATA (SURVEY)

PARTICLE SIZE ANALYSIS

| HORIZON | % PASSING 3 SIEVE | .75 SIEVE | NO.4 SIEVE | NO.10 SIEVE | V.C. SAND | C. SAND | MED. SAND | F. SAND | V.F. SAND | TOT. SAND | % OF SAMPLE 70-2U SILT | 50-2U SILT | 2U CLAY | 0.2U CLAY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LFH | | | 95 | 95 | | | | | | | | | | |
| BM | | 94 | 83 | 78 | 4 | 11 | 22 | 20 | 11 | 68 | | 22 | 10 | |
| C | | 96 | 77 | 72 | 4 | 11 | 24 | 23 | 12 | 74 | | 18 | 8 | |
| R | | | | | | | | | | | | | | |

PHYSICAL DATA

SURVEY (CON'T)

MOISTURE STATUS (%)

| HORIZON | 0.1 ATM | 0.33 ATM | 15 ATM | HYGR. MOIST | FIELD MOIST |
|---|---|---|---|---|---|
| LFH | | | | | |
| BM | | | 6.2 | | |
| C | | | 4.9 | | |
| R | | | | | |

## Appendix E

## GUIDES FOR ASSESSING SOIL SUITABILITY FOR AGRICULTURAL LAND USE

### Definitions of the Agricultural Capability Classes

Class 1

Soils in this class have no important limitations for crop use. The soils have level or gently sloping topography; they are deep, well to imperfectly drained and have moderate water holding capacity. The soils are naturally well supplied with plant nutrients, easily maintained in good tilth and fertility; soils are moderately high to high in productivity for a wide range of cereal and special crops.

Class 2

Soils in this class have moderate limitations that reduce the choice of crops or require moderate conservation practices. The soils have good water holding capacity and are either naturally well supplied with plant nutrients or are highly responsive to inputs of fertilizer. They are moderate to high in productivity for a fairly wide range of crops. The limitations are not severe and good soil management and cropping practices can be applied without serious difficulty.

Class 3

Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices. The limitations in Class 3 are more severe than those in Class 2 and conservation practices are more difficult to apply and maintain. The limitations affect the timing and ease of tillage, planting and harvesting, the choice of crops and maintenance of conservation practices. The limitations include one or more of the following: moderate climatic limitation, erosion, structure or permeability, low fertility, topography, overflow, wetness, low water holding capacity or slowness in release of water to plants, stoniness and depth of soil to consolidated bedrock. Under good management, these soils are fair to moderately high in productivity for a fairly wide range of field crops.

Class 4

Soils in this class have severe limitations that restrict the choice of crops or require special conservation practices or both. These soils have such limitations that they are only suited for a few crops, or the yield for a range of crops may be low, or the risk of crop failure is high. The limita-

tions may seriously affect such farm practices as the timing and ease of tillage, planting and harvesting, and the application and maintenance of conservation practices. These soils are low to medium in productivity for a narrow range of crops but may have higher productivity for a specially adapted crop. The limitations include the adverse effects of one or more of the following: climate, accumulative undesirable soil characteristics, low fertility, deficiencies in the storage capacity or release of soil moisture to plants, structure or permeability, salinity, erosion, topography, overflow, wetness, stoniness, and depth of soil to consolidated bedrock.

Class 5

Soils in this class have very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible. These soils have such serious soil, climatic or other limitations that they are not capable of use for sustained production of annual field crops. However, they may be improved by the use of farm machinery for the production of native or tame species of perennial forage plants. Feasible improvement practices include clearing of bush, cultivation, seeding, fertilizing and water control.

Some soils in Class 5 can be used for cultivated field crops provided unusually intensive management is used. Some of these soils are also adapted to special crops requiring soil conditions unlike those needed by the common crops.

Class 6

Soils in this class are capable only of producing perennial forage crops and improvement practices are not feasible. Class 6 soils have some natural sustained grazing capacity for farm animals, but have such serious soil, climatic or other limitations as to make impractical the application of improvement practices that can be carried out on Class 5 soils. Soils may be placed in this class because their physical nature prevents the use of farm machinery, or because the soils are not responsive to improvement practices, or because stock watering facilities are inadequate.

Class 7

Soils in this class have no capability for arable culture or permanent pasture because of extremely severe limitations. Bodies of water too small to delineate on the map are included in this class. These soils may or may not have a high capability for forestry, wildlife and recreation.

## Appendix F

## GUIDES FOR EVALUATING SOIL SUITABILITY FOR SELECTED USES

Table 15. Guide for assessing soil suitability as source of topsoil.

The term "topsoil" includes soil materials used to cover barren surfaces exposed during construction, and materials used to improve soil conditions on lawns, gardens, flower beds, etc. The factors to be considered include not only the characteristics of the soil itself, but also the ease or difficulty of excavation, and where removal of topsoil is involved, accessibility to the site.

| Symbol[1/] | Items Affecting Use | Degree of Soil Suitability | | | |
|---|---|---|---|---|---|
| | | Good - G | Fair - F | Poor - P | Very Poor - V |
| u | Moist Consistence[2/] | Very friable, friable | Loose, firm | Very firm | Cemented |
| i | Flooding | None | May flood occasionally for short periods | Frequent flooding | Constantly flooded |
| w | Wetness[2/] | Wetness is not determining if better than very poorly drained. | | | Very poorly drained and permanently wet soils |
| t | Slope | 0-5% | 5-9% | 9-15% | >15% |
| p | Stoniness[2/] | Stones 10 m apart (Class 0 and 1) | Stones 2-10 m apart (Class 2) | Stones 0.1-2 m apart (Class 3 and 4) | Stones 0.1 m apart (Class 5) |
| c | Coarse fragments[2/]: percent, by volume | <3% | 3-15% | 15-35% | >35% |
| s | Texture[2/] | FSL, VFSL, L, SiL, SL, SC if 1:1 clay is dominant | CL, SCL, SiCL, SC if 2:1 clay is dominant; c and sic if 1:1 clay is dominant | S, LS, C and SiC if 2:1 clay is dominant. organic soils[3/] | Marl, diatomaceous earth |
| b | Depth of Topsoil[4/] | >40 cm | 15-40 cm | 8-15 cm | <8 cm |
| n | Salinity of Topsoil[5/] | E.C. 0-1 | E.C. 1-4 | E.C. 4-8 | E.C. >8 |

1/ The symbols are used to indicate the nature of the limitation.

2/ For an explanation of texture, consistence, stoniness, coarse fragments and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

3/ Non-woody organic materials are assessed as good sources for topsoil if mixed with or incorporated into mineral soil.

4/ The remaining soil material (at least 8 cm) must be reclaimable after the uppermost soil is removed.

5/ E.C. = Electrical Conductivity (millisiemens/cm).

Table 16. Guide for assessing soil suitability as source of sand and gravel.

The purpose of this table is to provide guidance for assessing the probable supply as well as quality of the sand or gravel for use as road base material and in concrete. The interpretation pertains mainly to the characteristics of the soil substratum to a depth of 150 cm, augmented by observations made in deep cuts as well as geological knowledge where available.

| Symbol[1/] | Items Affecting Use | Degree of Soil Suitability | | | |
|---|---|---|---|---|---|
| | | Good - G | Fair - F | Poor - P | Very Poor - V |
| a | Unified Soil Group | SW<br>SP<br><br>GW<br>GP | SW-SM<br>SP-SM<br><br>GP-GM<br>GW-GM | SM<br>SW-SC<br>SP-SC<br>GM<br>GP-GC<br>GW-GC | All other groups and bedrock |
| h | Depth to Seasonal Water Table | Not class determining if deeper than 50 cm | | 50 cm | |
| q | Depth to Sand and Gravel | <25 cm | 25-75 cm[2/] | >75 cm[2/] | |
| p | Stoniness[3/] | Not class determining if stones >.5 m apart (Class 0, 1, 2 and 3) | | Stones 0.1-0.5 m apart (Class 4) | Stones <0.1 m apart (Class 5) |
| d | Depth to Bedrock | >100 cm | 50-100 cm | <50 cm | |

1/ The symbols are used to indicate the nature of the limitation.

2/ Rated good if it is known that the underlying gravel or sand deposit is thick (>100 cm).

3/ For an explanation of stoniness and rockiness, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

Table 17. Guide for assessing soil suitability as source of roadfill.

Fill material for buildings or roads are included in this use. The performance of the material when removed from its original location and placed under load at the building site or road bed are to be considered. Since surface materials are generally removed during road or building construction their properties are disregarded. Aside from this layer, the whole soil to a depth of 150-200 cm should be evaluated. Soil materials which are suitable for fill can be considered equally suited for road subgrade construction.

| Symbol 1/ | Items Affecting Use 2/ | Degree of Soil Suitability | | | |
|---|---|---|---|---|---|
| | | Good - G | Fair - F | Poor - P | Very Poor - V |
| a | Subgrade 3/ | | | | |
| | a. AASHO group index 4/ | 0-4 | 5-8 | >8 | |
| | b. Unified soil classes | GW, GP, SW, SP, SM, GC 5/ and SC 5/ | CL (with P.I. 6/ < 15) and ML | CL (with P.I. 6/ of 15 or more), CH and MH 7/ | OL, OH and Pt |
| l | Shrink-swell potential | Low | Moderate | High | |
| f | Susceptibility to frost action 8/ | Low | Moderate | High | |
| t | Slope | 0-15% | 15-30% | 30-45% | >45% |
| p | Stoniness 9/ | Stones >2 m apart (Class 0, 1 and 2) | Stones 0.5-2 m apart (Class 3) | Stones 0.1-0.5 m apart (Class 4) | Stones < 0.1 m apart (Class 5) |
| r | Rockiness 9/ | Rock exposures >35 m apart and cover <10% of the surface | Rock exposure 10-35 m apart and cover 10-25% of the surface | Rock exposure 3.5-10 m apart and cover 25-50% of the surface | Rock exposures < 3.5 m apart and cover 50-90% of the surface |
| w | Wetness 9/ | Excessively drained to moderately well drained | Imperfectly drained | Poorly drained | Very poorly drained or permanently wet soils |
| d | Depth to Bedrock | >100 cm | 50-100 cm | 20-50 cm | <20 cm |
| h | Depth to Seasonal Water Table | >150 cm | 75-150 cm | 50-75 cm | <50 cm |

1/ The symbols are used to indicate the nature of the limitation.

2/ The first three items pertain to soil after it is placed in a fill; the last six items pertain to soil in its natural condition before excavation for road fill.

3/ This item estimates the strength of the soil material, that is, its ability to withstand applied loads.

4/ Use AASHO group index only where laboratory data are available for the kind of soil being rated; otherwise, use Unified soil groups.

5/ Downgrade suitability rating to fair if content of fines is more than about 30 percent.

6/ P.I. means plasticity index.

7/ Upgrade suitability rating to fair if MH is largely kaolinitic, friable, and free of mica.

8/ Use this item only where frost penetrates below the paved or hardened surface layer and where moisture transportable by capillary movement is sufficient to form ice lenses at the freezing front.

9/ For an explanation of stoniness, rockiness and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

Table 18 Guide for assessing soil suitability for permanent buildings[1].

This guide applies to undisturbed soils to be evaluated for single-family dwellings and other structures with similar foundation requirements. The emphasis for rating soils for buildings is on foundation requirements; but soil slope, susceptibility to flooding and other hydrologic conditions, such as wetness, that have effects beyond those related exclusively to foundations are considered too. Also considered are soil properties, particularly depth to bedrock, which influence excavation and construction costs for the building itself and for the installation of utility lines. Excluded are limitations for soil corosivity, landscaping and septic tank absorption fields.

| Symbol[2] | Items Affecting Use | Degree of Soil Suitability[3] | | | |
|---|---|---|---|---|---|
| | | Good - G | Fair - F | Poor - P | Very Poor - V |
| w | Wetness[4] | With Basements: Very rapidly, rapidly and well drained. Without Basements: Very rapidly, rapidly, well and moderately well drained. | With Basements: Moderately well drained. Without Basements: Imperfectly drained. | With Basements: Imperfectly, poorly, and very poorly drained. Without Basements: Poorly and very poorly drained. | With Basements: Permanently wet soils. Without Basements: Permanently wet soils. |
| h | Depth to Seasonal Water Table | With Basements: >150 cm Without Basements: >75 cm | With Basements: 75-150 cm Without Basements: 50-75 cm | With Basements: 25-75 cm Without Basements: 25-50 cm | With Basements: <25 cm Without Basements: <25 cm |
| i | Flooding | None | None | Occasional flooding (once in 5 years) | Frequent flooding (every year) |
| t | Slope[5] | 0-9% | 9-15% | 15-30% | >30% |
| s | Subgrade[6] | | | | |
| | a. AASHO group index[7] | 0-4 | 5-8 | >8 | |
| | b. Unified soil classes | GW, GP, SW, SP, SM and GC and SC | CL (with P.I.[8] <15) and ML | CL (with P.I.[8] of 15 or more), CH and MH | OH, OL and Pt |
| f | Potential Frost Action[9] | Low (F1, F2) | Moderate (F3) | High (F4) | |
| p | Stoniness[4] | Stones >10 m apart (Class 0 to 1) | Stones 2-10 m apart (Class 2[10]) | Stones 0.1-2 m apart (Class 3[10] to 4) | Stones <0.1 m apart (Class 5[10]) |
| r | Rockiness[4],[11] | Rock exposures >100 m apart and cover <2% of the surface | Rock exposures 30-100 m apart and cover 2-10% of the surface | Rock exposures <30 m apart and cover >10% of the surface | Rock exposures too frequent to allow location of permanent buildings |
| d | Depth to Bedrock[11] | With Basements: >150 cm Without Basements: >100 cm | With Basements: 100-150 cm Without Basements: 50-100 cm | With Basements: 50-100 cm Without Basements: <50 cm | With Basements: <50 cm |

1/ By halving the slope limits, this table can be used for evaluating soil suitability for buildings with large floor areas, but with foundation requirements not exceeding those of ordinary three-storey dwellings.

2/ The symbols are used to indicate the nature of the limitation.

3/ Some soils assessed as fair or poor may be good sites from an aesthetic or use standpoint, but they will require more site preparation and/or maintenance.

4/ For an explanation of rockiness, stoniness and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

5/ Reduce the slope limits by one half for those soils subject to hillside slippage.

6/ This item estimates the strength of the soil, that is, its ability to withstand applied loads. When available, AASHO Group Index values from laboratory tests were used; otherwise the estimated Unified classes were used.

7/ Group index values were estimated from information published by the Portland Cement Association (PCA, 1962), pp. 23-25.

8/ P.I. means plasticity index.

9/ Frost heave only applies where frost penetrates to the assumed depth of the footings and the soil is moist. The potential frost action classes are taken from the United States Army Corps of Engineers (1962), pp. 5-8.

10/ Rate one class better for buildings without basements.

11/ Rate one class better if the bedrock is soft enough so that it can be dug with light power equipment such as backhoes.

Table 19. Guide for assessing soil suitability for local roads and streets[1].

This guide applies to soils to be evaluated for construction and maintenance of local roads and streets. These are improved roads and streets having some kind of all-weather surfacing, commonly asphalt or concrete, and are expected to carry automobile traffic all year. They consist of: (1) the underlying local soil material (either cut or fill) called the subgrade; (2) the base material of gravel, crushed rock, or lime or soil cement stabilized soil called the subbase; and (3) the actual road surface or pavement, either flexible or rigid. They also are graded to shed water and have ordinary provisions for drainage. With the probable exception of the hardened surface layer, the roads and streets are built mainly from the soil at hand, and cuts and fills are limited, usually less than 2 meters. Excluded from consideration in this guide are highways designed for fast-moving, heavy trucks.

Properties that affect design and construction of roads and streets are: (1) those that affect the load supporting capacity and stability of the subgrade, and (2) those that affect the workability and amount of cut and fill. The AASHO and Unified Classification give an indication of the traffic supporting capacity. Wetness and flooding affect stability. Slope, depth of hardrock, stoniness, rockiness, and wetness affect the ease of excavation and the amount of cut and fill to reach an even grade.

| Symbol[2] | Items Affecting Use | Degree of Soil Suitability | | | |
|---|---|---|---|---|---|
| | | Good - G | Fair - F | Poor - P | Very Poor - V |
| w | Wetness[3] | Very rapidly, rapidly, well and moderately well drained | Imperfectly drained | Poorly and very poorly drained | Permanently wet soils |
| i | Flooding | None | Infrequent (once in 5 years) | Occasional (once in 2-4 years) | Frequent (every year) |
| t | Slope | 0-9% | 9-15% | 15-30% | >30% |
| d | Depth to Bedrock[4] | >100 cm | 50-100 cm | <50 cm | |
| a | Subgrade[5] | | | | |
| | a. AASHO group index[6] | 0-4 | 5-8 | >8 | |
| | b. Unified soil classes | GW, GP, SW, SP, SM, GC[7] and SC[7] | CL (with P.I.[8] <15) and ML | CL (with P.I.[8] of 15 or more), CH and MH | OH, OL and Pt |
| f | Susceptibility to Frost Heave[9] | Low (F1, F2) | Moderate (F3) | High (F4) | |
| p | Stoniness[3] | Stones >2 m apart (Class 0 to 2) | Stones 0.5-2 m apart (Class 3) | Stones 0.1-0.5 m apart (Class 4) | Stones <0.1 m apart (Class 5) |
| r | Rockiness[3] | Rock exposures >100 m apart and cover <2% of the surface | Rock exposures 30-100 m apart and cover 2-10% of the surface | Rock exposures <30 m apart and cover >10% of the surface | Rock exposures too frequent to permit location of roads and streets |

1/ These guidelines, with some adjustment of slope and rockiness limits, will also be useful for assessing soils for use as parking lots.

2/ Symbols are used to indicate the nature of the limitation.

3/ For an explanation of stoniness, rockiness and soil drainage classes, see the Canada Soil Information System (Canada Soil Survey Committee, 1978).

4/ Rate one class better if the bedrock is soft enough so that it can be dug with light power equipment and is rippable by machinery.

5/ This item estimates the strength of soil materials as it applies to roadbeds. When available, AASHO Group Index values from laboratory tests were used; otherwise, the estimated Unified classes were used. The limitations were estimated assuming that the roads would be surfaced. On unsurfaced roads, rapidly drained, very sandy, poorly graded soils may cause washboard or rough roads.

6/ Group index values were estimated from information published by the Portland Cement Association (PCA, 1962) pp. 23-25.

7/ Downgrade to moderate if content of fines (less than 200 mesh) is greater than about 30 percent.

8/ P.I. means plasticity index.

9/ Frost heave is important where frost penetrates below the paved or hardened surface layer and moisture transportable by capillary movement is sufficient to form ice lenses at the freezing point. The susceptibility classes are taken from the United States Army Corps of Engineers (1962) pp. 5-8.

Table 20. Guide for assessing soil suitability for trench-type sanitary landfills[1/].

The trench-type sanitary landfill is a sanitary landfill, in which dry garbage and trash is buried daily in an open trench and covered with a layer of soil material. Suitability of the site is dependent upon the potential for pollution of water sources through groundwater contact with the refuse, or leachate arising from the site. Those properties affecting ease of excavation of the site must be supplemented with geological and hydrological knowledge to provide subsurface soil and groundwater data to a depth of at least 3 to 4.5 m, a common depth of landfills.

| Symbol[2/] | Items Affecting Use | Degree of Soil Suitability | | | |
|---|---|---|---|---|---|
| | | Good - G[3/] | Fair - F | Poor - P | Very Poor - V |
| h | Depth to Seasonal High Water Table | Not class determining if more than 180 cm | | 100-180 cm | <100 cm |
| w | Wetness[4/] | Not class determining if better than imperfectly drained | | Imperfectly drained | Poorly and very poorly drained or permanently wet soils |
| i | Flooding | None | Rare | Occasional | Frequent |
| k | Permeability[5/] | <5 cm/hr | <5 cm/hr | 5-15 cm/hr | >15 cm/hr |
| t | Slope | 0-15% | 15-30% | 30-45% | >45% |
| s | Soil Texture[4/,6/] (dominant to a depth of 150 cm) | SL, L, SiL, SCL | SiCL[7/], CL, SC, LS | SiC, C | Muck, peat, gravel, sand |
| d | Depth to Hard Bedrock<br>Rippable | >150 cm<br>>150 cm | >150 cm<br>100-150 cm | 100-150 cm<br>100-150 cm | <100 cm<br><100 cm |
| p | Stoniness[4/] | Stones >10 m apart (Class 0 and 1) | Stones 2-10 m apart (Class 2) | Stones 0.1-2 m apart (Class 3 and 4) | Stones <0.1 m apart (Class 5) |
| r | Nature of Bedrock | Impermeable | | | Highly permeable, fractured, easily soluble |

1/ Based on soil depth (120 cm) commonly investigated in making soil surveys.

2/ The symbols are used to indicate the nature of the limitation.

3/ If probability is high that the soil material to a depth of 3 to 4.5 m will not alter a rating of good or fair, indicate this by an appropriate footnote, such as "Probably good to a depth of 3.5 m", or "Probably fair to a depth of 3.5 m".

4/ For an explanation of stoniness, texture and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

5/ Reflects ability of soil to retard movement of leachate from the landfills; may not reflect a limitation in arid and semiarid areas.

6/ Reflects ease of digging and moving (workability) and trafficability in the immediate area of the trench where there may not be surfaced roads.

7/ Soils high in expansive clays may need to be given a suitability rating of poor.

Table 21. Guide for assessing soil suitability for area-type sanitary landfills.

In the area-type sanitary landfill refuse is placed on the surface of the soil in successive layers. The daily and final cover material generally must be imported. A final cover of soil material at least 60 cm thick is placed over the fill when it is completed.

The soil under the proposed site should be investigated so as to determine the probability that leachates from the landfill can penetrate the soil and thereby pollute water supplies.

| Symbol 1/ | Items Affecting Use | Degree of Soil Suitability | | | |
|---|---|---|---|---|---|
| | | Good - G | Fair - F | Poor - P | Very Poor - V |
| h | Depth to Seasonal Water Table 2/ | >150 cm | 150-100 cm | 50-100 cm | <50 cm |
| w | Wetness 2/, 3/ | Rapid to moderately well drained | Imperfectly drained | Poorly drained | Very poorly drained or permanently wet soils |
| i | Flooding | None | Rare | Occasional | Frequent |
| k | Permeability 4/, 5/ | Not class determining if less than 5 cm/hr | | 5-15 cm/hr | >15 cm/hr |
| t | Slope | 0-9% | 9-15% | 15-30% | >30% |

1/ The symbols are used to indicate the nature of the limitation.

2/ Reflects influence of wetness on operation of equipment.

3/ For an explanation of drainage, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

4/ Reflects ability of the soil to retard movement of leachate from landfills; may not reflect a limitation in arid and semiarid areas.

5/ Due to possible groundwater contamination, impermeable bedrock is considered poor and permeable bedrock is rated very poor for area-type sanitary landfills.

Table 22. Guide for assessing soil suitability as cover material for area-type sanitary landfills.

The term cover material includes soil materials used to put a daily and final covering layer on refuse in area-type sanitary landfills. This cover material may be derived from the area of the landfill or may be brought in from surrounding areas.

| Symbol[1/] | Items Affecting Use | Degree of Soil Suitability | | | |
|---|---|---|---|---|---|
| | | Good - G | Fair - F | Poor - P | Very Poor - V |
| u | Moist Consistence[2/] | Very friable, friable | Loose, firm | Very firm | Cemented |
| s | Texture[2/,3/] | SL, L, SiL, SCL | SiCL, CL, SC, LS | SiC, C | Muck, peat, sand, gravel |
| d | Depth to bedrock[4/] | >150 cm | 100-150 cm | 50-100 cm | <50 cm |
| c | Coarse fragments[2/] | <15% | 15-35% | >35% | |
| p | Stoniness[2/] | Stones >10 m apart (Class 0 and 1) | Stones 2-10 m apart (Class 2) | Stones 0.1-2 m apart (Class 3 and 4) | Stones < 0.1 m apart (Class 5) |
| t | Slope | <9% | 9-15% | 15-30% | >30% |
| w | Wetness[2/] | Not class determining if better than poorly drained | | Poorly drained | Very poorly drained or permanently wet soils |

1/ The symbols are used to indicate the nature of the limitation.

2/ For an explanation of consistence, texture, coarse fragments, stoniness and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

3/ Soils having a high proportion of non-expansive clays may be given a suitability rating one class better than is shown for them in this table.

4/ Thickness of material excluding topsoil, which will be stockpiled (see guide for topsoil).

Table 23. Guide for assessing soil suitability for reservoirs and sewage lagoons.

Factors affecting the ability of undisturbed soils to impound water or sewage and prevent seepage are considered for evaluating soils on their suitability for reservoir and lagoon areas. This evaluation considers soil both as a vessel for the impounded area and as material for the enclosing embankment. As the impounded liquids could be potential sources of contamination of nearby water supplies, e.g. sewage lagoons, the landscape position of the reservoir as it affects risk of flooding must also be considered.

| Symbol[1/] | Items Affecting Use | Degree of Soil Suitability | | | |
|---|---|---|---|---|---|
| | | Good - G | Fair - F | Poor - P | Very Poor - V |
| h | Depth to Water Table[2/] | >150 cm | 100-150 cm | 50-100 cm | <50 cm |
| i | Flooding[3/] | None | None | Subject to infrequent flooding (once in 50 years) | Subject to frequent high level flooding |
| k | Soil Permeability | 0-0.5 cm/hr | 0.5-5 cm/hr | 5-15 cm/hr | >15 cm/hr |
| t | Slope | 0-2% | 2-5% | 5-9% | >9% |
| o | Organic Matter | <2% | 2-10% | 10-30% | >30% |
| c | Coarse Fragments[4/] <25 cm in diameter, % by volume | <20% | 20-35% | >35% | |
| p | Stoniness[4/], >25 cm diameter, percent of surface area | <3% (Class 0, 1 and 2) | 3-15% (Class 3) | 15-50% (Class 4) | >50% (Class 5) |
| d | Depth to Bedrock[5/] | >150 cm | 100-150 cm | 50-100 cm | <50 cm |
| j | Thickness of Slowly Permeable Layer | >100 cm | 50-100 cm | 50-25 cm | <25 cm |
| a | Subgrade Unified Soil Classes | GC, SC, CL, & CH | GM, ML, SM & MH | SW & SP | OL, OH & Pt GP, GW |

1/ The symbols are used to indicate the nature of the limitation.

2/ If the floor of the lagoon has nearly impermeable material at least 50 cm thick, disregard depth to water table.

3/ Disregard flooding if it is not likely to enter or damage the lagoon (flood waters have low velocity and depth less than 150 cm).

4/ For an explanation of coarse fragments and stoniness classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

5/ Surface exposures of non rippable rock are rated very poor. If underlying bedrock is impermeable, rating should be one class better.

Table 24. Guide for assessing soil suitability for septic tank absorption fields.

This guide applies to soils to be used as an absorption and filtering medium for effluent from septic tank systems. A subsurface tile system laid in such a way that effluent from the septic tank is distributed reasonably uniformly into the natural soil is assumed when applying this guide. A rating of poor need not mean that a septic system should not be installed in the given soil, but rather, may suggest the difficulty, in terms of installation and maintenance, which can be expected.

| Symbol[1/] | Items Affecting Use | Degree of Soil Suitability | | | |
|---|---|---|---|---|---|
| | | Good - G | Fair - F | Poor - P | Very Poor - V |
| k | Permeability[2/] | Rapid to moderately rapid | Moderate | Slow | Very slow |
| | Percolation Rate[3/] (Auger hole method) | About 8-18 min/cm[3/] | 18-24 min/cm | Slower than 24 min/cm | |
| h | Depth to Seasonal Water Table[4/] | >150 cm[5/] | 100-150 cm | 50-100 cm | <50 cm |
| i | Flooding | Not subject to flooding | Not subject to flooding | Subject to occasional flooding (once in 5 years) | Floods every year |
| t | Slope | 0-9% | 9-15% | 15-30% | >30% |
| d | Depth to Hard Rock, bedrock or other impervious materials | >150 cm | 100-150 cm[6/] | 50-100 cm | <50 cm |

1/ The symbols are used to indicate the nature of the limitation.

2/ The suitability ratings should be related to the permeability of soil layers at and below depth of the tile line.

3/ Soils having a percolation rate less than about 8 min/cm are likely to present a pollution hazard to adjacent waters. This hazard must be noted, but the degree of hazard must, in each case, be assessed by examining the proximity of the proposed installation to water bodies, water table, and related features. The symbol g is used to indicate this condition. Refer to U.S. Dept. of Health, Education and Welfare (1969) for details of this procedure.

4/ Seasonal means for more than one month. It may, with caution, be possible to make some adjustment for the severity of a water table limitation in those cases where seasonal use of the facility does not coincide with the period of high water table.

5/ A seasonal water table should be at least 100 cm below the bottom of the trench at all times for soils rated Good (U.S. Dept. of Health, Education and Welfare, 1969). The depths used to water table are based on an assumed tile depth of 50 cm. Where relief permits, the effective depth above a water table or rock can be increased by adding appropriate amounts of fill.

6/ Where the slope is greater than 9%, a depth to bedrock of 100-150 cm is assessed as poor.

Table 25 Guide for assessing soil suitability for playgrounds.

This guide applies to soils to be used intensively for playgrounds for baseball, football, badminton, and for other similar organized games. These areas are subject to intensive foot traffic. A nearly level surface, good drainage, and a soil texture and consistence that gives a firm surface generally are required. The most desirable soils are free of rock outcrops and coarse fragments.

Soil suitability for growing and maintaining vegetation is not a part of this guide, except as influenced by moisture, but is an important item to consider in the final evaluation of site.

| Symbol[1/] | Items Affecting Use | Degree of Soil Suitability | | | |
|---|---|---|---|---|---|
| | | Good - G | Fair - F | Poor - P | Very Poor - V |
| w | Wetness[2/] | Rapidly, well and moderately well drained soils with no ponding or seepage. Water table below 75 cm during season of use. | Moderately well drained soils subject to occasional seepage or ponding of short duration and imperfectly drained soils. Water table below 50 cm during season of use. | Imperfectly drained soils subject to seepage or ponding, and poorly drained soils. Water table above 50 cm during season of use. | Very poorly drained and permanently wet soils. |
| i | Flooding | None during season of use. | Occasional flooding. May flood once every 2-3 years during season of use. | Floods every year during season of use. | Prolonged flooding during season of use. |
| k | Permeability | Very rapid to moderate. | Moderately slow and slow. | Very slow. | |
| t | Slope | 0-2% | 2-5% | 5-9% | >9% |
| d | Depth to Bedrock | >100 cm | 50-100 cm[3/] | <50 cm[3/] | |
| c | Coarse fragments on surface[2/] | Relatively free of coarse fragments. | <20% coarse fragments. | >20% coarse fragments. | |
| p | Stoniness[2/] | Stones >10 m apart. (Class 0 to 1) | Stones 2-10 m apart. (Class 2) | Stones 0.1-2 m apart. (Class 3, 4) | Stones <0.1 m apart. (Class 5) |
| r | Rockiness[2/] | Rock exposures >100 m apart and cover <2% of the surface. | Rock exposures 30-100 m apart and cover about 2-10% of the surface. | Rock exposures <30 m apart and cover >10% of the surface. | Rock outcrops too frequent to permit playground location. |
| s | Surface Soil Texture[2/,4/] | SL, FSL, VFSL, L | SiL, CL, SCL, SiCL, LS | SC, SiC, C[5/]; S, Si | Peaty soils; S and LS subject to blowing. |
| q | Depth to Sand or Gravel[6/] | >100 cm | 50-100 cm | <50 cm | |
| m | Useful Moisture[7/] | Water storage capacity[8/] >15.0 cm and/or adequate rainfall and/or low evapotranspiration. | Water storage capacity[8/] 7.5-15 cm and/or moderate rainfall and/or moderate evapotranspiration. | Water storage capacity[8/] <7.5 cm and/or low rainfall and/or high evapotranspiration. | |

1/ The symbols are used to indicate the nature of the limitation.

2/ See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978). Coarse fragments for the purpose of this table include gravels and cobbles.

3/ Downgrade to a very poor suitability rating if the slope is greater than 5%.

4/ Surface soil texture influences soil ratings as it affects foot trafficability, surface wetness, dust, and maintenance. Adverse soil textures may be partially or completely overcome with the addition of topsoil.

5/ Moderately well and well drained SC, SiC and C soils may be rated fair.

6/ Depth to sand or gravel is considered a limitation in that levelling operations may expose sand or gravel, thereby bringing about adverse surface textures and undesirable amounts of coarse fragments. The addition of topsoil after the levelling process would overcome this limitation.

7/ This item attempts to evaluate the adequacy of moisture for vegetative growth. It incorporates the concept of supply through rainfall, loss through evapotranspiration, and storage within the rooting zone. In soils where the water table is within rooting depth for a significant portion of the year, water storage capacity may not significantly influence vegetation growth.

8/ Consult glossary for definitions of terms used.

Table 26. Guide for assessing soil suitability for picnic areas.

This guide applies to soils considered for intensive use as park-type picnic areas. It is assumed that most vehicular traffic will be confined to the access roads. Soil suitability for growing and maintaining vegetation is not a part of this guide, except as influenced by moisture, but is an important item to consider in the final evaluation of site.

| Symbol[1/] | Items Affecting Use | Degree of Soil Suitability | | | |
|---|---|---|---|---|---|
| | | Good - G | Fair - F | Poor - P | Very Poor - V |
| w | Wetness[2/] | Very rapidly, rapidly, well and moderately well drained soils not subject to seepage or ponding. Water table below 50 cm during season of use. | Moderately well drained soils subject to occasional seepage or ponding and imperfectly drained soils not subject to ponding or seepage. Water Table above 50 cm for short periods during season of use. | Imperfectly drained soils subject to seepage or ponding. Poorly drained soils. Water table above 50 cm and often near surface for a month or more during season of use. | Very poorly drained and permanently wet soils. |
| i | Flooding | None during season of use. | May flood 1 or 2 times per year for short periods during season of use. | Floods more than 2 times during season of use. | Prolonged flooding during season of use. |
| t | Slope | 0-9% | 9-15% | 15-30% | >30% |
| s | Surface Soil Texture[2/,3/] | SL, FSL, VFSL, L | SiL, CL, SCL, SiCL, LS, and sand other than loose sand. | SC, SiC, C[4/]; Si | Peaty soils; loose sand subject to blowing. |
| c | Coarse Fragments on Surface[2/] | 0-20% | 20-50% | >50% | |
| p | Stoniness[2/] | Stones >2 m apart (Class 0 to 2) | Stones 1-2 m apart (Class 3) | Stones 0.1-1 m apart (Class 4) | Stones <0.1 m apart (Class 5) |
| r | Rockiness[2/,5/,6/] | Rock exposures roughly 30-100 or more m apart and cover <10% of the surface. | Rock exposures roughly 10-30 m apart and cover 10-25% of the surface. | Rock exposures <10 m apart and cover >25% of the surface. | Rock exposures too frequent to permit location of picnic areas. |
| m | Useful Moisture[7/] | Water storage capacity[8/] >15 cm and/or adequate rainfall and/or low evapotranspiration. | Water storage capacity[8/] 7.5-15 cm and/or moderate rainfall and/or moderate evapotranspiration. | Water storage capacity[8/] <7.5 cm and/or low rainfall and/or high evapotranspiration. | |

1/ The symbols are used to indicate the nature of the limitation.

2/ See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978). Coarse fragments for the purpose of this table, include gravels and cobbles. Some gravelly soils may be rated as having a slight limitation if the content of gravel exceeds 20% by only a small margin providing (a) the gravel is embedded in the soil matrix, or (b) the fragments are less than 2 cm in size.

3/ Surface soil texture influences soil ratings as it affects foot trafficability, dust and soil permeability.

4/ Moderately well and well drained SC, SiC and C soils may be rated fair.

5/ Very shallow soils are rated as having severe or very severe limitations for stoniness or rockiness.

6/ The nature and topography of the bedrock exposures may significantly alter these ratings. As such, on-site investigations will be necessary in map units containing bedrock when these are considered as possible sites.

7/ This item attempts to evaluate the adequacy of moisture for vegetative growth. It incorporates the concept of supply through rainfall, loss through evapotranspiration, and storage within the rooting zone. In soils where the water table is within rooting depth for a significant portion of the year, water storage capacity may not significantly influence vegetation growth.

8/ Consult glossary for definitions of terms used.

Table 27. Guide for assessing soil suitability for camp areas.

This guide applies to soils to be used intensively for tents and camp trailers and the accompanying activities of outdoor living. It is assumed that little site preparation will be done other than shaping and levelling for campsites and parking areas. The soil should be suitable for heavy foot traffic by humans and limited vehicular traffic. Soil suitability for growing and maintaining vegetation is not a part of this guide, but is an important item to consider in the final evaluation of site.

Back country campsites differ in design, setting and management but require similar soil attributes. These guides should apply to evaluations for back country campsites but depending on the nature of the facility the interpreter may wish to adjust the criteria defining a given degree of limitation to reflect the changed requirement. For example, small tentsites may allow rock exposures greater than 10 m apart to be considered a slight limitation.

| Symbol[1/] | Items Affecting Use | Degree of Soil Suitability | | | |
|---|---|---|---|---|---|
| | | Good - G | Fair - F | Poor - P | Very Poor - V |
| w | Wetness[2/] | Very rapidly, rapidly, well and moderately well drained soils with no seepage or ponding. Water table below 75 cm during season of use. | Moderately well drained soils subject to occasional seepage or ponding and imperfectly drained soils with no seepage or ponding. Water table below 50 cm during season of use. | Imperfectly drained soils subject to seepage or ponding and poorly drained soils. Water table above 50 cm during season of use. | Very poorly drained and permanently wet soils. |
| i | Flooding | None | Very occasional flooding during season of use. Once in 5-10 years. | Occasional flooding during season of use. Once in 2-4 years. | Flooding during every season of use. |
| k | Permeability | Very rapid to moderate inclusive. | Moderately slow and slow. | Very slow. | |
| t | Slope | 0-9% | 9-15% | 15-30% | >30% |
| s | Surface Soil Texture[2/,3/] | SL, FSL, VFSL, L | SiL, SCL, CL, SiCL, LS, and sand other than loose sand. | SC, SiC, C[4/]; Si | Peaty soils; loose sand subject to blowing. |
| c | Coarse Fragments on Surface[2/,5/] | 0-20% | 20-50% | >50% | |
| p | Stoniness[2/,6/] | Stones >10 m apart (Class 0 and 1) | Stones 2-10 m apart (Class 2) | Stones 0.1-2 m apart (Class 3 and 4) | Stones < 0.1 m apart (Class 5) |
| r | Rockiness[2/,6/] | No rock exposures | Rock exposures >10 m apart and cover <25% of the area. | Rock exposures <10 m apart and cover >25% of the area. | Rock exposures too frequent to permit campground location. |

1/ The symbols are used to indicate the nature of the limitation.

2/ See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

3/ Surface soil texture influences soil ratings as it affects foot trafficability, dust, and soil permeability.

4/ Moderately well and well drained SC, SiC and C soils may be rated fair.

5/ Coarse fragments for the purpose of this table include gravels and cobbles. Some gravelly soils may be rated as having slight limitations if the content of gravel exceeds 20% by only a small margin, providing (a) the gravel is embedded in the soil matrix, or (b) the fragments are less than 2 cm in size.

6/ Very shallow soils are rated as having a limitation for rockiness and/or stoniness.

Table 28 Guide for assessing soil suitability for paths and trails.

It is assumed that the trails will be built at least 45 cm wide and that obstructions such as cobbles and stones will be removed during construction. It is also assumed that a dry, stable tread is desirable and that muddy, dusty, worn or eroded trail treads are undesirable. Hiking and riding trails are not treated separately, but as the design requirements for riding trails are more stringent, a given limitation will be more difficult to overcome. Poor or very poor suitability does not indicate that a trail cannot or should not be built. It does, however, suggest higher design requirements and maintenance to overcome the limitations.

| Symbol 1/ | Items 2/ Affecting Use | Degree of Soil Suitability | | | |
|---|---|---|---|---|---|
| | | Good - G | Fair - F | Poor - P | Very Poor - V |
| s | Texture 3/, 4/ | SL, FSL, VFSL, LS, L | SiL, CL, SiCL, SCL | SC, SiC, C 5/; Sand, Si | Peaty soils; loose sand subject to blowing |
| c | Coarse Fragment Content 4/, 6/ | 0-20% | 20-50% | >50% | |
| p | Stoniness 4/ | Stones >2 m apart (Class 0 to 2) | Stones 1-2 m apart (Class 3) | Stones 0.1-1 m apart (Class 4) | Stones <0.1 m apart (Class 5) |
| w | Wetness 4/ | Very rapidly, rapidly well, and moderately well drained soils. Water table below 50 cm during season of use. | Moderately well drained soils subject to occasional seepage and ponding and imperfectly drained soils. Water table may be above 50 cm for short periods during season of use. | Poorly and very poorly drained soils. Water table above 50 cm and often near surface for a month or more during season of use. | Permanently wet soils. |
| r | Rockiness 4/, 7/ | Rock exposures >30 m apart and cover <10% of the surface. | Rock exposures 10-30 m apart and cover 10-25% of the surface. | Rock exposures <10 m apart and cover >25% of the surface. | Rock exposures too frequent to permit location of paths and trails. |
| t | Slope 8/ | 0-15% | 15-30% | 30-60% | >60% |
| i | Flooding | Not subject to flooding during season of use. | Floods 1 or 2 times during season of use. | Floods more than 2 times during season of use. | Subject to prolonged flooding during season of use. |

1/ The symbols are used to indicate the nature of the limitation.

2/ The items affecting use listed in this table are those which have been shown to cause significant differences in trail response. Elevation, aspect, position on slope, and snow avalanching may have slight affects or influence trail management and should be considered in the final site evaluation. Items such as vegetation, fauna, and scenic value are not considered in the guidelines (Epp, 1977).

3/ Texture refers to the soil texture which will form the tread texture. This is the surface texture on level areas but may be a subsurface texture on slopes. Textural classes are based on the less than 2 mm soil fraction. Texture influences soil ratings as it influences foot trafficability, dust, design or maintenance of trails, and erosion hazards.

4/ See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

5/ Moderately well and well drained SC, SiC and C soils may be rated fair.

6/ Coarse fragments for the purpose of this table, include gravels and cobbles. Gravels tend to cause unstable footing when present in high amounts, and are also associated with increased erosion. Cobbles (and stones) must be removed from the trail tread, increasing construction and maintenance difficulties. Some gravelly soils may be rated as having a slight limitation if the content of gravel exceeds 20% by only a small margin providing (a) the gravel is embedded in the soil matrix or (b) the fragments are less than 2 cm in size.

7/ The type of rock outcrop (flat lying vs cliffs), and the orientation of the structure (linear cliffs vs massive blocks) can greatly alter the degree of the limitation. Each site with a Rockiness limitation based on the percent rock outcrop above should be evaluated on its own merits and the degree of limitation should then be modified appropriately if necessary.

8/ Slope in this context refers to the slope of the ground surface, not the slope of the tread.

## Appendix G

## SOIL LEGEND FOR FLIN FLON STUDY AREA

MAP LEGEND - FLIN FLON AREA

| Map Symbol | Soil Name | Dominant Texture | Natural Drainage | Surficial Geology: Soil Material | Surficial Geology: Landform | Soil Taxonomy | Dominant Vegetation |
|---|---|---|---|---|---|---|---|
| AKX | Atik Complex | Mesic Peat | Poor to Very Poor | Shallow (40-160 cm) mesic forest peat or very thin (<65 cm) fibric Sphagnum peat overlying mesic forest peat. Underlain by strongly calcareous, loamy to clayey, stone-free, lacustrine sediments. | Level to depressional flat and blanket bog | Terric Mesisol*<br>Terric Mesisol, sphagnic phase<br>Terric Fibric Mesisol<br>Terric Mesic Fibrisol | Black spruce with an understory of Sphagnum and feather-mosses & ericaceous shrubs |
| aR | Acidic Bedrock | - | Rapid Runoff | 0 to 10 cm of variable textured mineral and organic materials overlying acidic Precambrian bedrock | Steep, hummocky and undulating bedrock | - | Some jack pine, black spruce and lichens |
| CNN | Channing Series | Sand and Gravel overlying Clay | Well | Non-calcareous, stratified sands and gravels overlying moderately to strongly calcareous lacustrine clay | Undulating glacio-fluvial outwash | Eluviated Dystric Brunisol | Aspen, some jack pine |
| CLF | Cliff Series | Sand and Gravel overlying Clay | Imperfect to somewhat Poor | Non-calcareous, stratified sands and gravels overlying moderately to strongly calcareous lacustrine clay | Gently undulating glaciofluvial outwash | Gleyed Eluviated Dystric Brunisol | Aspen, willow, black spruce |
| FYK | Fay Lake Series | Sandy Loam | Well | Non-calcareous, very stony sandy loam till derived from Precambrian granitic and volcanic rocks. | Moderately to strongly rolling morainal plain | Eluviated Dystric Brunisol | Jack pine, black spruce |
| HGX | Hargrave Complex | Mesic Peat | Poor to Very Poor | Deep (>160 cm) mesic forest peat or very thin (<65 cm) fibric Sphagnum peat overlying mesic forest peat. Underlain by undifferentiated materials. | Level to depressional flat and blanket bog | Typic Mesisol*<br>Typic Mesisol, sphagnic phase | Black spruce with an understoy of Sphagnum, feather-mosses, & ericaceous shrubs |
| MDR | Medard Series | Clay | Poor | 15 to 40 cm of mesic peat overlying moderately to strongly calcareous, clayey, stone-free lacustrine sediments. | Depressional to level lacustrine sediments | Rego Gleysol | Black spruce, Labrador tea, Sphagnum and feathermosses |

| Map Symbol | Soil Name | Dominant Texture | Natural Drainage | Surficial Geology: Soil Material | Surficial Geology: Landform | Soil Taxonomy | Dominant Vegetation |
|---|---|---|---|---|---|---|---|
| PCP | Partridge Crop Series | Coarse Sand and Gravel | Well | Non-calcareous, moderately stony, stratified sands and gravels | Undulating to ridged glacio-fluvial outwash | Eluviated Dystric Brunisol | Aspen, jack pine |
| REX | Reed Lake Complex | Mesic Peat | Very Poor to Poor | Shallow (40-160 cm) mesic fen peat or little or no (<65 cm) fibric Sphagnum peat overlying mesic forest peat. Underlain by strongly calcareous, loamy to clayey, stone-free lacustrine sediments. | Depressional to level horizontal and ribbed fen | Terric Mesisol* Terric Mesisol, sphagnic phase | Sedges and mosses with clumps of stunted black spruce and tamarack |
| RLX | Rock Island Complex | Mesic Peat | Very Poor | Deep (>160 cm) mesic fen peat, or little or no (<65 cm) fibric Sphagnum peat overlying mesic fen peat. Underlain by undifferentiated materials. | Depressional to level horizontal and ribbed fen | Typic Mesisol* Typic Mesisol, sphagnic phase | Sedges, mosses, swamp birch & tamarack |
| ROK | Roe Lake Series | Clay | Imperfect | Moderately to strongly calcareous, clayey, stone-free lacustrine sediments. | Level to gently undulating lacustrine sediments | Gleyed Gray Luvisol | Black spruce, white spruce, & aspen |
| SWK | Sipiwesk Series | Clay | Well | Moderately to strongly calcareous stone-free lacustrine clay. | Undulating glacio-lacustrine sediments | Orthic Gray Luvisol | Black spruce, white spruce, aspen |
| WBW | Wabowden Series | Clay | Well | Moderately to strongly calcareous, stone-free lacustrine clay. | Undulating glacio-lacustrine sediments. | Solonetzic Gray Luvisol | Black spruce, white spruce, aspen |
| WVT | Wolverton Series | Sandy Loam over/aR | Well | Thin (<100 cm) non-calcareous, very stony, sandy loam till derived from Precambrian granitic and volcanic rocks overlying Precambrian bedrock. | Moderately to strongly rolling morainal veneer | Eluviated Dystric Brunisol | Jack pine, black spruce |
| ZZ | Water bodies | | | | | | |

* Dominant Soil Series